United States
Department of
Agriculture

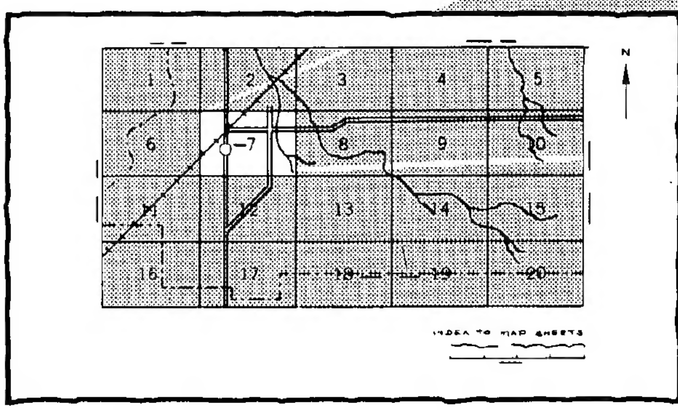
Soil
Conservation
Service

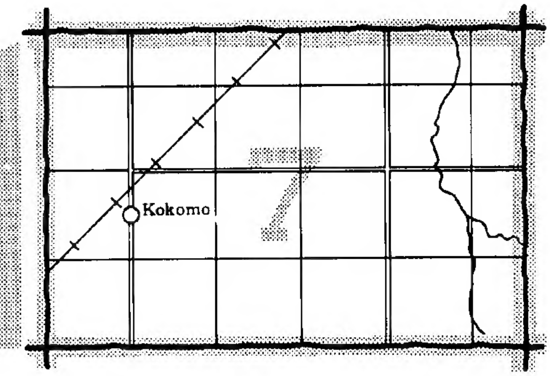
In cooperation with
University of Nebraska
Conservation and
Survey Division

Soil Survey of Rock County Nebraska

HOW TO USE

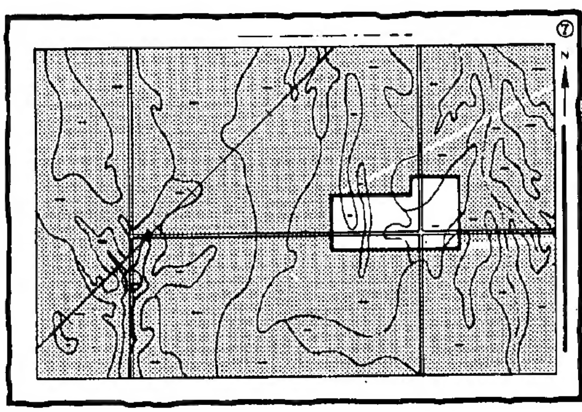
1. Locate your area of interest on the "Index to Map Sheets"

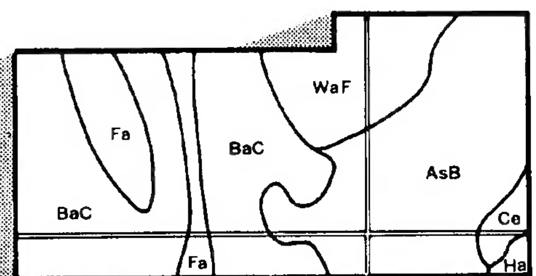




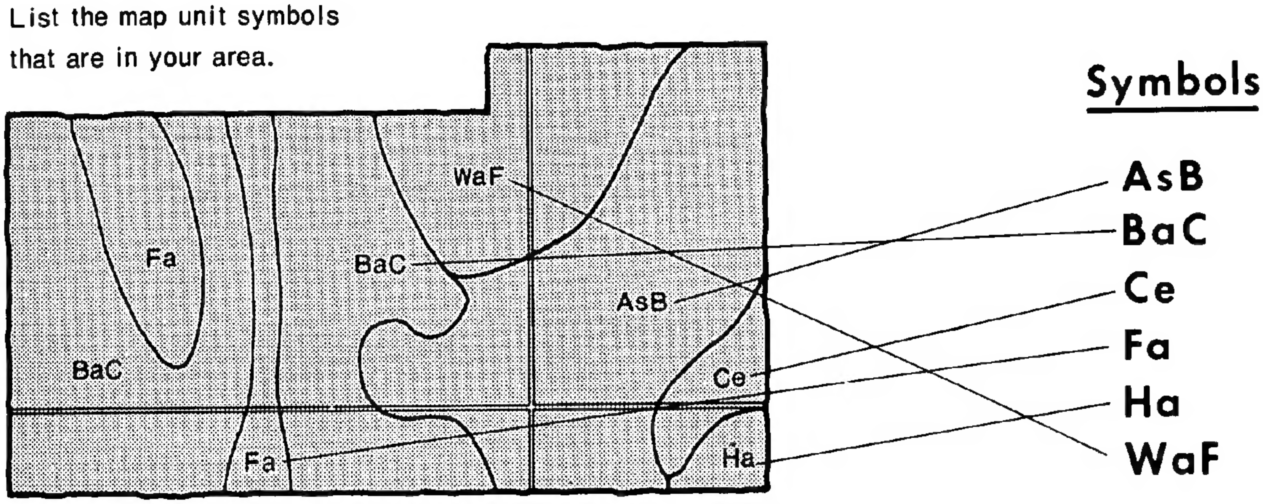
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



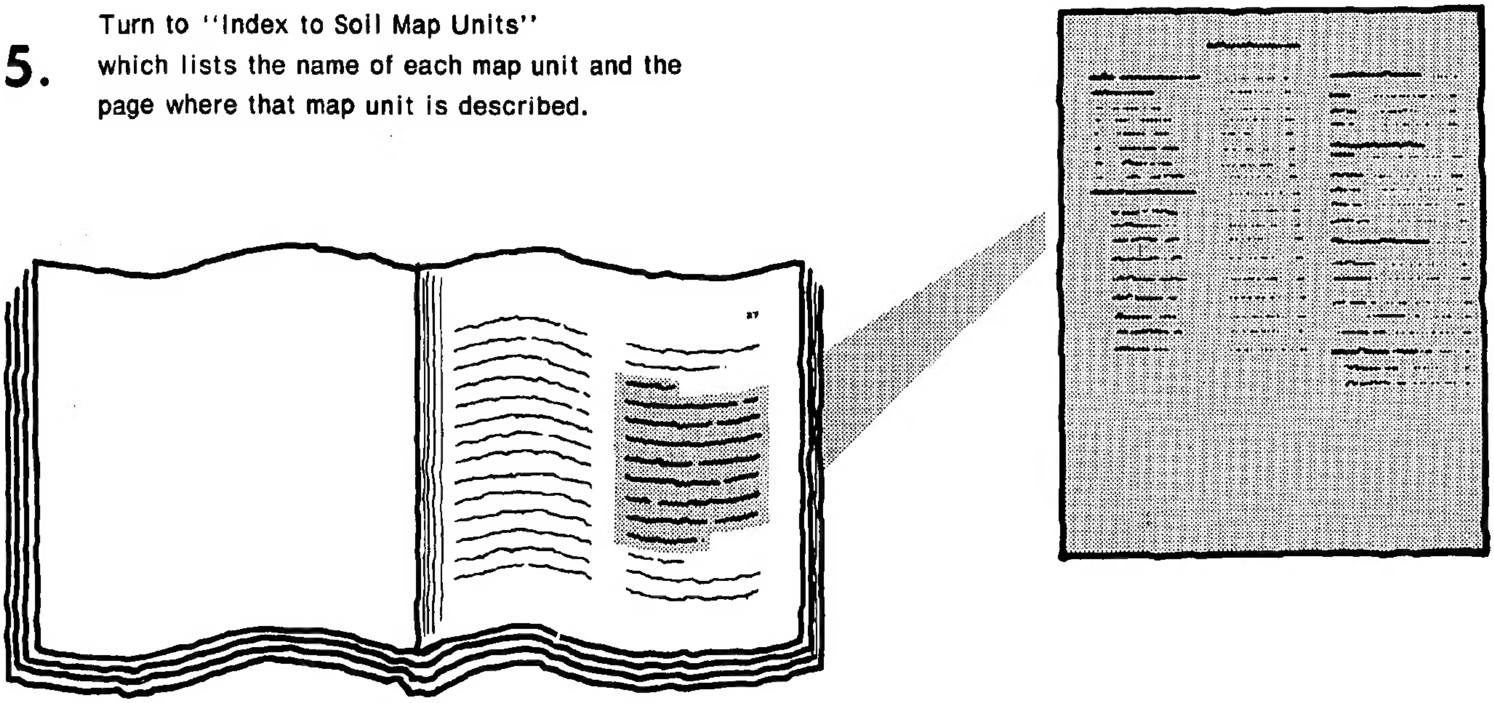


4. List the map unit symbols that are in your area.

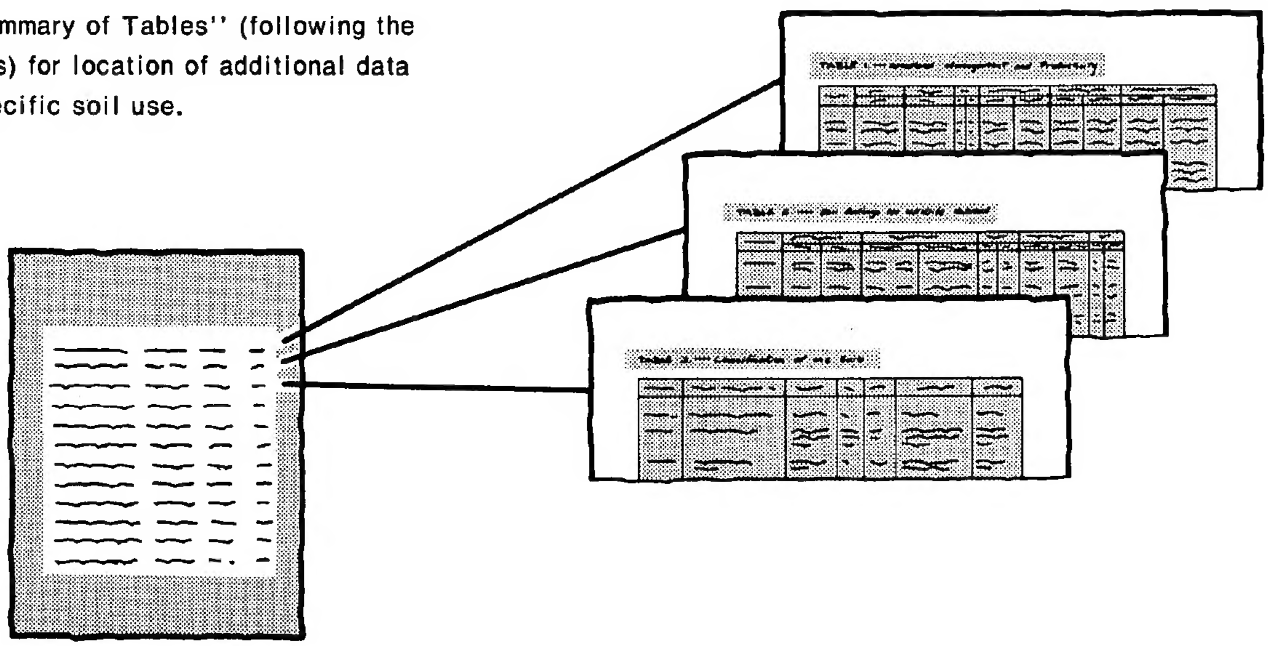


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

This survey was made cooperatively by the Soil Conservation Service and the University of Nebraska, Conservation and Survey Division. It is part of the technical assistance furnished to the Lower Loup Natural Resources District, Lower Niobrara Natural Resources District, Middle Niobrara Natural Resources District, and Upper Elkhorn Natural Resources District. The Rock County Board of Commissioners and the Natural Resources Districts provided financial assistance to commission aerial photography and assigned employee soil scientists to assist in accelerating this survey. Major fieldwork for this soil survey was completed in 1981. Soil names and descriptions were approved in 1982. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1982.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: On this farm in the sandhills, windbreaks prevent soil erosion and protect livestock and buildings. For cultivated crops, such as corn, sprinkler irrigation is used to offset the droughtiness of the soils. The farmstead and windbreaks are on Boelus soils, and the irrigated cornfield in the background is in an area of Valentine soils.

Contents

Soil Series

Issued May 1985

Index to Map Units

Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Rock County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Sherman L. Lewis

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State Conservationist
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Soil Survey of
Rock County, Nebraska

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University of Nebraska, Conservation and Survey Division

United States Department of Agriculture, Soil Conservation Service,
in cooperation with the University of Nebraska,
Conservation and Survey Division

ROCK COUNTY is in the north-central part of Nebraska (fig. 1). It is 22 miles wide and about 49 miles long at its longest point. The irregular northern boundary is formed by the deeply entrenched Niobrara River. Rock County is bordered on the south by Loup County, on the west by Brown County, on the north by Keya Paha County, and on the east by Holt County. The total area of the county is 650,880 acres, or about 998 square miles. The county seat and largest town is Bassett, which has a population of approximately 960 people.

Ranching and farming are the main occupations in Rock County. The general economy of the county is based primarily on cattle ranching and the production of hay and irrigated crops. Corn and alfalfa are the most extensively grown crops. These crops, along with native hay, provide feed for the county's beef-cattle industry. The surplus is sold for cash income.

About 70 percent of the soils in Rock County are in the uplands and sandhills. These soils formed in eolian sand or in sandy and loamy outwash material. The soils along streams and drainageways formed in alluvium. Clayey soils are in the northern part of the county and on breaks to the Niobrara River. The remaining 30 percent of the soils are in wet sandhill valleys or on bottom lands. They formed in sandy and loamy eolian or alluvial material.

The main hazards associated with upland soils are water erosion and soil blowing. The low available water capacity and low fertility of the soils, as well as insufficient rainfall, limit production of cultivated crops in the upland areas. The principal hazards associated with soils in sandhill valleys or on bottom lands are soil blowing and wetness caused by the seasonal high water table. Occasional flooding and wetness from the seasonal high water table limit production of cultivated crops.

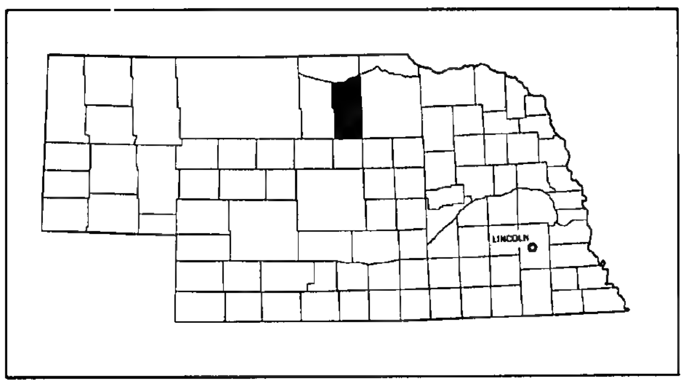

Figure 1.—Location of Rock County in Nebraska.

The first soil survey of Rock County was made in 1937. This survey updates the first survey by providing additional information and larger maps that show the soils in greater detail (*7*).

General Nature of the Survey Area

This section provides general information about Rock County. It discusses history and development; climate;

physiography, relief, and drainage; geology; ground water; and trends in farming.

History and Development

The first European believed to have reached the area now known as Rock County was James McKay, a Scotsman, who explored the Nebraska Sandhills in the years 1795 and 1796. Gold seekers and military expeditions also passed through this region in the 1860's and 1870's. The first settlers in the area were small farmers and ranchers who settled as early as 1870. These first settlers came largely from eastern and southeastern Nebraska.

In 1871, the town of Bassett was founded and named after J. W. Bassett, a cattleman who grazed cattle in the area and lived near the townsite. In 1888, Rock County was officially organized by a general election. The county's name was derived from Rock Creek, a small stream in the northern part of the county that held a deposit of excellent building stone. Prior to the formation of Rock County, the area was a part of Brown County, organized in 1883.

On January 29, 1889, after considerable conflict as to location, the town of Bassett was made the county seat. The first courthouse, built in 1889, was destroyed by fire in 1899. The second courthouse was replaced by the present building in 1941 (*3*).

The first railroad to reach Rock County was the Fremont, Elkhorn, and Missouri Valley Railroad. This railroad was extended to Bassett in the fall of 1881. It is now the Chicago Northwestern Railroad and connects Omaha, Nebraska to Lander, Wyoming (*4*).

Transportation facilities are available throughout the county. The Chicago Northwestern Railroad serves Bassett and Newport. U.S. Highway 20 provides an all-weather east-west route in the northern part of the county. U.S. Highway 183 provides an all-weather north-south route through the central part of the county. The rural road system in the county is generally built along section lines, except in sandhill areas. Most roads are graveled and a few have an asphalt surface. The railroad, highways, and county roads provide the means of transporting grain and livestock to main marketing terminals to the south and east.

A modern high school and elementary school are located in Bassett. Many elementary schools are in rural areas.

According to the 1980 census, Rock County had a population of 2,383, and Bassett had a population of 1,009. The county's population gradually declined since the 1930's, when the population was 3,336. The number of ranches in the county has decreased as individual operations have become larger. Most of the people in Rock County live in the northern half of the county.

Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Winters in Rock County are cold because of frequent incursions of cold, continental air that bring spells of low temperatures. Summers are hot with occasional interruptions of cooler air from the north. Snowfall is fairly frequent in winter, but snow cover is usually not continuous. Rainfall is heaviest in late spring and early summer. Annual precipitation is normally adequate for wheat, sorghum, and range grasses.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Newport, Nebraska, in the period 1951 to 1980. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 23 degrees F, and the average daily minimum temperature is 12 degrees. The lowest temperature on record, which occurred at Newport on January 29, 1966, is -28 degrees. In summer the average temperature is 72 degrees, and the average daily maximum temperature is 86 degrees. The highest recorded temperature, which occurred at Newport on July 13, 1954, is 112 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 22 inches. Of this, 17 inches, or 75 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 13 inches. The heaviest 1-day rainfall during the period of record was 3.6 inches at Newport on May 3, 1964. Thunderstorms occur on about 47 days each year, and most occur in summer.

The average seasonal snowfall is about 42 inches. The greatest snow depth at any one time during the period of record was 18 inches. On the average, 45 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

Severe thunderstorms strike occasionally in spring when strong, dry winds blow over unprotected soils. Tornadoes and severe thunderstorms, some including hail, strike occasionally. These storms are local and of short duration, and the pattern of damage is variable and spotty.

The average relative humidity in midafternoon is about 50 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent

of the time possible in summer and 60 percent in winter. The prevailing wind is from the northwest. Average windspeed is highest, 13 miles per hour, in spring.

Physiography, Relief, and Drainage

Rock County is in the Great Plains physiographic province. This county includes parts of four general landform divisions, known as the Niobrara Valley, Holt Table, Elkhorn Valley, and the Sandhills. Unlike Holt County, where the landforms have become rather well defined, most of the land surface in Rock County has been so greatly modified by windblown sand that the Holt Table, Elkhorn Valley, and the Niobrara Valley landforms are poorly defined.

The Niobrara Valley landform consists of terrace remnants and escarpments, or breaks, into the Niobrara River. Before the river became deeply entrenched, a continuous terrace 1 to 4 miles wide extended across the county between the Niobrara River and the older, slightly higher Holt Table. Today the terrace is dissected into smaller remnants by many deeply entrenched tributaries flowing northward into the Niobrara River. Relief generally is less than 10 feet. In most places, sandy material has covered the original loamy material of the terrace and has been whipped by the wind into a low rolling or undulating landscape.

The lowering of the base level that caused the Niobrara River to deepen its valley produced the rugged, steeply eroded landscape adjacent to the river. This landscape has the greatest relief in the county. Maximum relief between ridgetops and the bottom of the river valley is about 150 to 200 feet. The upper part of these eroded breaks consists of windblown sand and weathered sandstone. The lower part consists of clay weathered from Pierre Shale.

The Holt Table makes up approximately 10 to 15 percent of the northern part of Rock County. It is just south of the Niobrara terrace and extends east to west across the county as a strip of land 10 to 12 miles wide. The relief in this landform is quite variable because tributaries from the Niobrara River have dissected and eroded many parts of the Holt Table. Areas of this landform consist of nearly level to very gently sloping tablelands interrupted by drainageways that have gently sloping to strongly sloping side slopes. In tableland areas, sand or gravel material lies directly below the loamy or sandy surface. On the upper parts of side slopes of drainageways, the sand and gravel material is exposed or very near the surface in places. On the lower parts of side slopes, weathered sandstone is exposed or very near the surface. In its western part, the Holt Table has been modified by sandhills that have been deposited over the older tableland.

The Elkhorn Valley is a nearly level to strongly sloping sandy plain. It lies south of the Holt Table. It makes up only about 20 percent of the county. The Elkhorn Valley occurs as a wedge-shaped body that extends eastward and southeastward toward the Holt County line from the vicinity of Bassett. The relief of this landform is generally less than 10 feet, although a few higher sandhill areas are present. The water table generally fluctuates between the surface and 6 feet during most of the growing season. Even during dry periods, marshes, ponds, and small shallow lakes are a characteristic feature of this landscape. A few small permanently flowing streams are in this area and together constitute a part of the Elkhorn River headwaters.

The Sandhills landform occupies the remaining 60 percent of the county and is best developed in the southern half of the county. The relief generally ranges from 30 to 70 feet. Over the greater part of this area, sand has been blown by the wind into a gently sloping to hilly landscape. Around the margins of the higher hills are lower lying valleys or small depressional pockets. These areas, some of which are quite large, have smoother slopes. Most valleys contain areas of poorly drained to somewhat poorly drained soils, marshes, and small shallow lakes. The permanently flowing streams of Bloody Creek, Skull Creek, and the Calamus River flow southward out of this sandhill area and are tributaries to the Loup River system. Small intermittent streams also flow north and east out of this area and add to the headwaters of the Elkhorn River.

Rock County is drained by the Niobrara, Elkhorn, and Loup Rivers and their tributaries. Drainage conditions are variable throughout the county. In the southern four-fifths of the county, most drainage occurs as subsurface drainage through the porous sands. Drainage channels in this area are, for the most part, poorly established or absent. Permanently flowing streams, such as the Calamus and Elkhorn Rivers, are rather slow-flowing and not deeply entrenched. In the Niobrara River Valley, however, drainage is better expressed. Here, land is subject to water erosion on slopes leading to the Niobrara River and its tributaries. Long Pine Creek, Sand Creek, Coon Creek, Laughing Water Creek, Rock Creek, Willow Creek, Oak Creek, and Ash Creek are swift-flowing streams that are deepening their channels. The Niobrara River is also a rather swift-flowing river and carries large amounts of sediment.

The lowest elevation in the county is in the north part and is about 1,800 feet above sea level. The highest point is in the central part and is about 2,600 feet above sea level. Bassett, the county seat, is at an elevation of about 2,343 feet.

Geology

The Pierre Shale is the oldest exposed formation in Rock County and consists of black to bluish-gray marine clay shales of Late Cretaceous age. The Pierre Shale outcrops along the lower slopes of the Niobrara River

Valley. Slopes formed on the Pierre Shale are subject to landslides.

The Ogallala Group of Miocene age overlies the Pierre Shale along the upper slopes of the Niobrara River Valley, and the unconformity between the two represents approximately 60 million years of geologic time. The Ogallala Group can be subdivided into a lower Valentine Formation, which is characterized by sands that range from gray to yellowish in color and from fine to medium in texture, and includes some clayey sands; and an upper Ash Hollow Formation, which is characterized by silty sandstones that range in color from gray to brown and are commonly cemented by calcium carbonate. The Ogallala Group is primarily alluvial in origin, and it commonly occupies old valleys cut into the Pierre Shale.

Unconsolidated alluvial sands and gravels of Early Pleistocene (and possibly some Late Pliocene) age overlie the Ogallala Group south from the Niobrara River breaks to 6 or 8 miles south of Highway 20, forming a broad sandy plain 10 to 12 miles wide in northern Rock County. The southern three-fourths of the county is covered by sand dunes that constitute the northeastern part of the Nebraska Sandhills. The dunes are as much as 125 feet high and consist primarily of well-sorted fine grained sand. Silts are in the interdune valleys. The present dune topography probably formed during arid intervals in Late Quaternary time.

Ground Water

Wells in Rock County provide water for irrigation, municipal, industrial, livestock, and domestic use. However, the ground water supply is not uniformly distributed throughout the county. In areas bordering the Niobrara River Valley and Long Pine Creek, the Pierre Shale of Late Cretaceous age is either exposed or is a few feet below the land surface. This rock unit is not known to yield water to wells. Throughout the rest of the county, ground water is available from rock units of the Ogallala Group of Miocene age and from the overlying unconsolidated deposits of Quaternary age.

The Ogallala Group is composed of beds of weakly cemented silt, sand, gravel, and layers of sandstone; and in most places, it yields adequate amounts of ground water for irrigation. The Quaternary deposits are composed principally of eolian sand, unconsolidated sand and gravel, and some beds of silt and clay. In places, high-yielding wells can be developed. In the sandhill areas, most of the wells producing from Quaternary deposits are shallow, low-yielding wells used for domestic and livestock needs.

The chemical quality of water in the county is commonly suitable for all uses. Generally, it is of the calcium carbonate type and is low in dissolved solids. However, the ground water in rocks that immediately overlie the Pierre Shale tends to be alkaline and high in dissolved solids.

The depth of water ranges from a few feet to 150 feet or more. The water level at many well sites is less than 25 feet.

Trends in Farming

Agriculture has been the foundation of the economy in Rock County since the county was settled. Throughout most of the county's history, cattlemen have used the native prairie for grazing or hayland; in recent years, areas have been developed for irrigated cropland. The U.S. Census of 1935 reported 610 farms in Rock County. According to the Nebraska Agricultural Statistics, this number dropped to 325 farms in 1960 and to 280 farms in 1980. This reduction is primarily due to increases in the size of the remaining farms (*6*).

Farm and ranch production has grown with the increased use of irrigation and commercial fertilizer. In 1962, the Nebraska Agriculture Statistics reported 14 registered irrigation wells in Rock County and 1,300 acres of land under irrigation. By 1981, the number of registered wells had increased to 532, and about 58,000 acres was under irrigation. This increase in irrigation in the last 20 years is due mainly to the introduction of the center-pivot type of irrigation system (*6*).

Corn is the main cultivated crop in the county. The acreage of irrigated corn increased from 110 acres in 1962 to 39,700 acres in 1980. Production of irrigated alfalfa hay has also increased over the past 20 years (*6*).

The acreage of dryland oats, wheat, and grain sorghum is in a general decline. In recent years, a small acreage of irrigated soybeans, potatoes, and grain sorghum has been planted in the county. Areas of native rangeland continue to be converted to cropland and are irrigated by the center-pivot systems.

Raising cattle and selling calves in the fall as feeders are still the largest agricultural industries in the county. A few ranches produce purebred cattle. The total number of cattle raised on farms and ranches increased from 68,500 head in 1963 to 86,000 head in 1980. The number of cattle in feedlots has also increased in the past 10 years. Dairy cattle, however, decreased in numbers from 1,700 in 1963 to 1,300 in 1980 (*6*).

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The

profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so

complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit, or soil association, on the general soil map is a unique natural landscape. Typically, a soil association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one soil association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Soil Associations

Nearly level to strongly sloping soils on bottom lands and in sandhill valleys

Two associations are in this group. The soils in both associations are deep. These excessively drained or somewhat poorly drained to very poorly drained sandy and loamy soils formed in eolian sediments and alluvium.

Most areas affected by wetness from the water table are used for native hayland or rangeland. Some areas of better drained soils are used for cropland. Most of the cropland is irrigated by center-pivot sprinkler systems from wells.

The main hazard on these associations is soil blowing, and the main limitation is wetness caused by the high water table. Other concerns of management are conserving soil moisture, maintaining a high level of fertility in cropland areas, and improving the condition of the native hayland and rangeland.

1. Els-Valentine-Tryon Association

Deep, nearly level to strongly sloping, excessively drained or somewhat poorly drained to very poorly drained, sandy soils that formed in eolian and alluvial sands; on bottom lands and sand ridges and in sandhill valleys

In this association, the landscape consists of hummocky sand ridges and the intervening valleys and swales (fig. 2). Slopes range mostly from 0 to 9 percent.

This association occupies about 228,080 acres, or about 35 percent of the county. It is about 39 percent Els soils, 29 percent Valentine soils, 18 percent Tryon soils, and 14 percent minor soils.

The Els soils are nearly level and very gently sloping and are somewhat poorly drained. They are on bottom lands and in sandhill valleys. Typically, the surface layer is grayish brown, very friable loamy sand about 9 inches thick. The next layer is light brownish gray, very friable fine sand about 9 inches thick. The underlying material to a depth of more than 60 inches is mottled pale brown and very pale brown fine sand.

The Valentine soils are nearly level to strongly sloping and are excessively drained. They are on sand ridges. Typically, the surface layer is grayish brown, loose fine sand about 6 inches thick. The next layer is brown, loose fine sand about 2 inches thick. The underlying material is pale brown fine sand to a depth of more than 60 inches.

The Tryon soils are nearly level and are poorly drained and very poorly drained. They are in sandhill valleys and on bottom lands. Typically, the surface layer is dark gray, very friable loamy fine sand about 5 inches thick. The next layer is light brownish gray, loose loamy sand about 5 inches thick. The underlying material to a depth of 60 inches or more is light gray sand in the upper part, grayish brown fine sand in the middle part, and gray and light gray sand in the lower part.

Of minor extent in this association are Elsmere, Ipage, Libory, Loup, and Marlake soils. Elsmere soils are dark to a depth of 10 inches or more and are somewhat poorly drained. Elsmere soils are on positions on the landscape similar to those of the Els soils. Ipage soils are on slightly higher, hummocky positions and are moderately well drained. Libory soils are also on slightly higher positions than the Els soils and have loamy underlying material. Loup soils are dark to a depth of 10 inches or more and are in positions on the landscape similar to those of the Tryon soils. Marlake soils are on the lowest positions on the landscape and are covered with water much of the time. A few areas of rolling to hilly sandhills are within areas of this association, and blowouts are common throughout.

Most of the acreage of this association is used for ranching, mainly cow-calf operations. Some of the nearly level to strongly sloping sandhill soils are used as cropland. These soils generally are too sandy for dry-farming and require irrigation. Corn and alfalfa are the

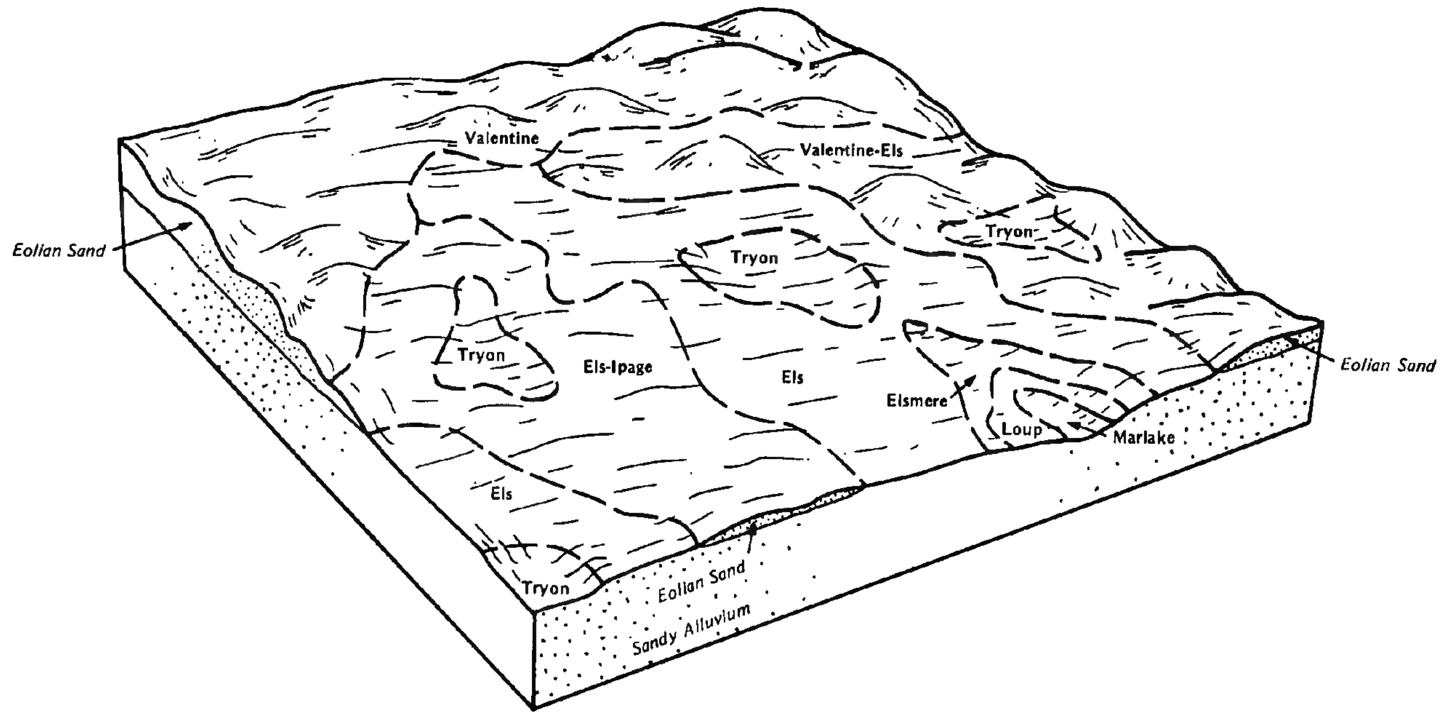

Figure 2.—Typical pattern of soils and parent material in the Els-Valentine-Tryon association.

main crops under irrigation. Wells produce good water sufficient for livestock and for center-pivot irrigation. Tryon soils are too wet for crops.

Soil blowing is the main hazard in both native grass and cultivated areas. Wetness from the high water table and the low available water capacity and low fertility of the soils are limitations. Soil blowing can be controlled by keeping the soil covered with crops or crop residue. The seasonal high water table interferes with both haying and tillage operations during wet seasons. Proper irrigation water management and application of fertilizer are concerns in management of cropland areas. Maintaining or improving the condition of the native grass is a management concern. This can be accomplished by proper grazing use, by timely haying, and by rotational grazing and haying systems that change the order of use and rest each year.

2. Loup-Elsmere Association

Deep, nearly level and very gently sloping, somewhat poorly drained to very poorly drained, loamy and sandy soils that formed in alluvial and eolian sands; on bottom lands

In this association, the landscape consists of broad, smooth bottom lands (fig. 3). Slopes range from 0 to 3 percent.

This association occupies about 58,938 acres, or about 9 percent of the county. It is about 42 percent Loup soils, 30 percent Elsmere soils, and 28 percent minor soils.

The Loup soils are nearly level and are poorly drained and very poorly drained. Typically, the surface layer is very dark gray, calcareous, very friable fine sandy loam about 7 inches thick. The subsurface layer is dark gray, friable fine sandy loam about 3 inches thick. The next layer is gray, friable loamy sand about 4 inches thick. The underlying material to a depth of more than 60 inches is light gray, mottled fine sand and loamy sand.

The Elsmere soils are nearly level and very gently sloping and somewhat poorly drained. Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 12 inches thick. The subsurface layer is dark grayish brown, very friable loamy fine sand about 7 inches thick. The next layer is grayish brown, very friable sand about 5 inches thick. The underlying material to a depth of more than 60 inches is light brownish gray sand in the upper part, mottled grayish brown loamy sand in the middle part, and mottled light brownish gray sand in the lower part.

Of minor extent in this association are the Els, Ipage, Marlake, Selia, Tryon, and Valentine soils. Els, Ipage, and Tryon soils have a dark surface layer less than 10 inches thick. Els and Selia soils are in positions on the

landscape similar to those of the Elsmere soils. Ipage soils are on slightly higher landscape positions. Marlake soils are on the lowest positions on the landscape and are covered by water much of the time. Selia soils are affected by sodium and are strongly alkaline. Valentine soils are excessively drained and are on higher hummocky landscape positions.

Ranches in this association are mainly cow-calf livestock enterprises. A large part of the acreage in this association is in native grass and is used for hayland or rangeland. Some of the Elsmere soil areas are farmed. Most cropland is used for alfalfa hay, but a few areas are under sprinkler irrigation and are used to produce corn. Wells supply adequate water for center-pivot irrigation systems.

Soil blowing and lowland flooding are the main hazards in both cultivated and native grass areas. Soil blowing can be controlled by keeping the soil covered with crops or crop residue. In some areas, wetness from the high water table and severe alkalinity are limitations. The seasonal high water table interferes with both haying and tillage operations during wet seasons. In areas managed for cropland, maintaining fertility and irrigation water management are concerns. Loup soils are too wet for use as cropland. Maintaining or improving the condition of the native hayland or rangeland is a management concern. This can be accomplished by proper grazing use, by timely haying, and by rotational grazing and haying systems that change the order of use and rest each year.

Nearly level to very steep soils in the sandhills

Only one association is in this group. The soils are deep, excessively drained, and sandy. They formed in eolian sand. Soils in this group are used mostly as rangeland. A small acreage is used as cropland and irrigated by center-pivot sprinkler systems from deep wells.

Soil blowing is a hazard if the grass cover is destroyed. Other concerns of management are maintaining a high level of fertility, conserving moisture, and improving the condition of the rangeland.

3. Valentine Association

Deep, nearly level to very steep, excessively drained, sandy soils that formed in eolian sand; in the sandhills

In this association, the landscape consists of steep, hummocky sandhills with intervening valleys (fig. 4). Slopes range from 0 to 60 percent. Many of the sandhills rise as much as 150 feet above the valley.

This association occupies about 208,457 acres, or about 32 percent of the county. It is about 95 percent Valentine soils and 5 percent minor soils.

Typically, the surface layer of the Valentine soils is grayish brown, loose fine sand about 4 inches thick. The

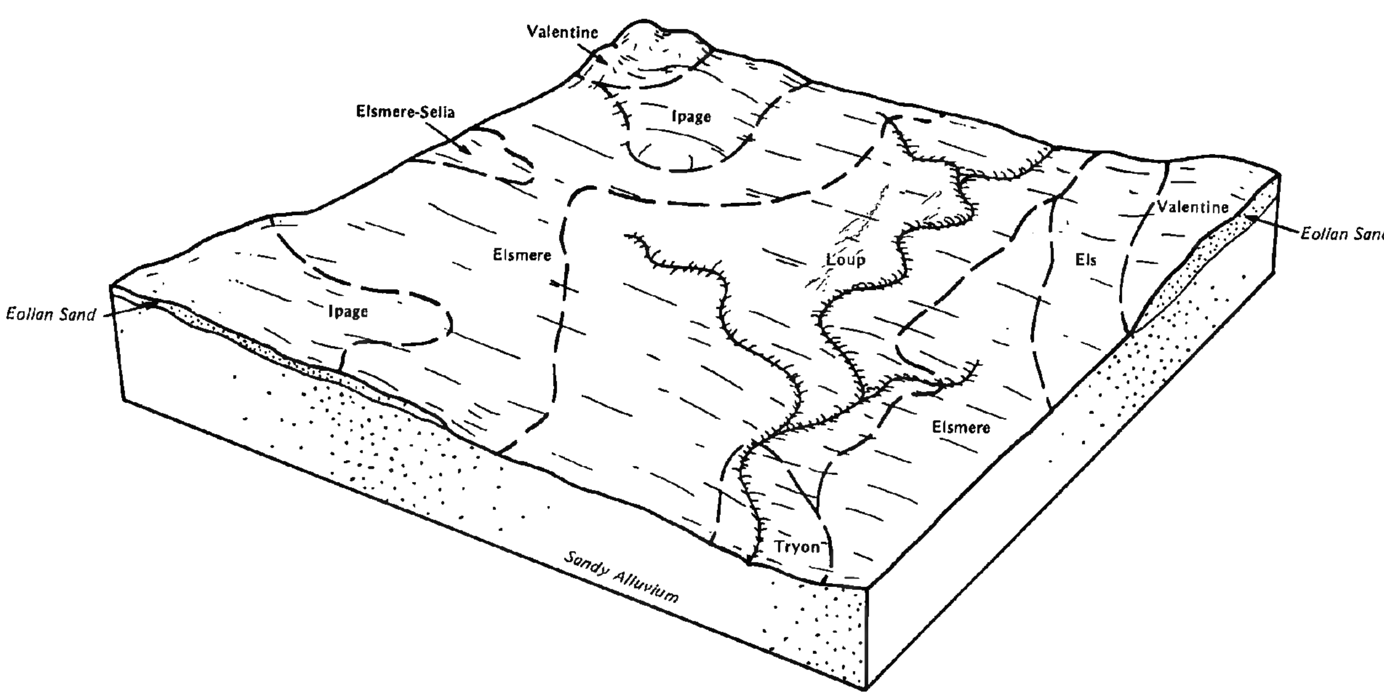

Figure 3.—Typical pattern of soils and parent material in the Loup-Elsmere association.

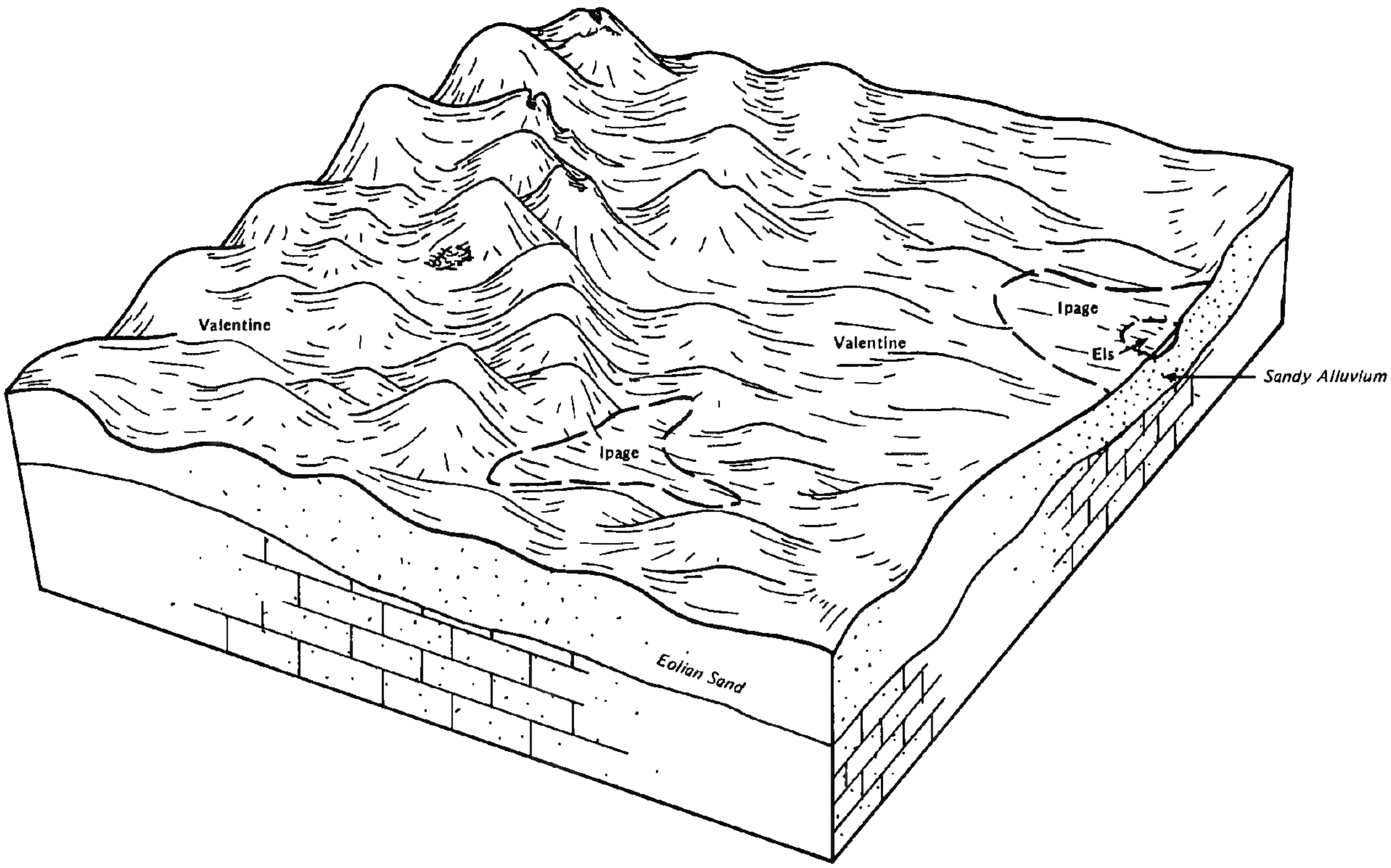

Figure 4.—Typical pattern of soils and parent material in the Valentine association.

next layer is brown, loose fine sand about 6 inches thick. The underlying material is pale brown fine sand to a depth of more than 60 inches.

Of minor extent in this association are the Boelus, Els, Ipage, and Dunday soils. Boelus soils are underlain by loamy material, are on nearly level uplands, and are well drained. Els soils are on bottom lands and are somewhat poorly drained. Ipage soils are in sandhill valleys and are moderately well drained. Dunday soils are on nearly level to very gentle slopes and have a dark surface layer thicker than 10 inches.

Farms and ranches in this association are mainly cow-calf livestock enterprises. Most of the acreage of this association is in native grass used for grazing. Only a few areas are used for hay because the valleys are too narrow for much more than scattered small meadows. In most areas of this association the soils are unsuited to cultivated crops because of the steepness of slope. A few areas of the more gently sloping soils are irrigated and used to produce corn and alfalfa. Wells provide good water sufficient for livestock and irrigation.

Soil blowing is the main hazard on the soils of this association. Low available water capacity and low fertility are the major soil limitations. Soil blowing can be controlled by keeping the soil covered with grass, crops or crop residue. Proper irrigation water management and proper application of fertilizers are concerns in cropland management. Maintaining or improving the condition of the native grass is a concern of management. This can be accomplished by proper grazing use, by timely haying, and by rotational grazing and haying systems that change the order of use and rest each year.

Nearly level to rolling soils on uplands and in the sandhills

Three associations are in this group. Soils in these associations range from well drained to excessively drained and are loamy. They formed in eolian and outwash material. About one-half of the acreage of this group of soils is used for cropland, and much of it is irrigated by center-pivot sprinkler systems from deep wells. The rest of the acreage is used mostly for rangeland.

Soil blowing and water erosion are the main hazards on these sandy soils. Low available water capacity is a limitation. Other concerns of management are conservation of soil moisture and management of irrigation water.

4. Valentine-Dunday Association

Deep, nearly level to strongly sloping, well drained and excessively drained, sandy soils that formed in eolian sand; on uplands and in sandhills

This association consists of well drained and excessively drained soils in sandhills and on uplands (fig. 5). Slopes range from 0 to 9 percent. The soils in this association formed in eolian sands.

This association occupies about 52,580 acres, or about 8 percent of the county. It is about 80 percent Valentine soils, 10 percent Dunday soils, and 10 percent minor soils.

The Valentine soils are nearly level to strongly sloping and are excessively drained. Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 6 inches thick. The next layer is grayish brown, very friable loamy fine sand about 6 inches thick. The underlying material is pale brown and light gray fine sand and sand to a depth of more than 60 inches.

The Dunday soils are level to very gently sloping and are well drained. Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 11 inches thick. Below this layer is grayish brown, very friable loamy fine sand about 11 inches thick. The

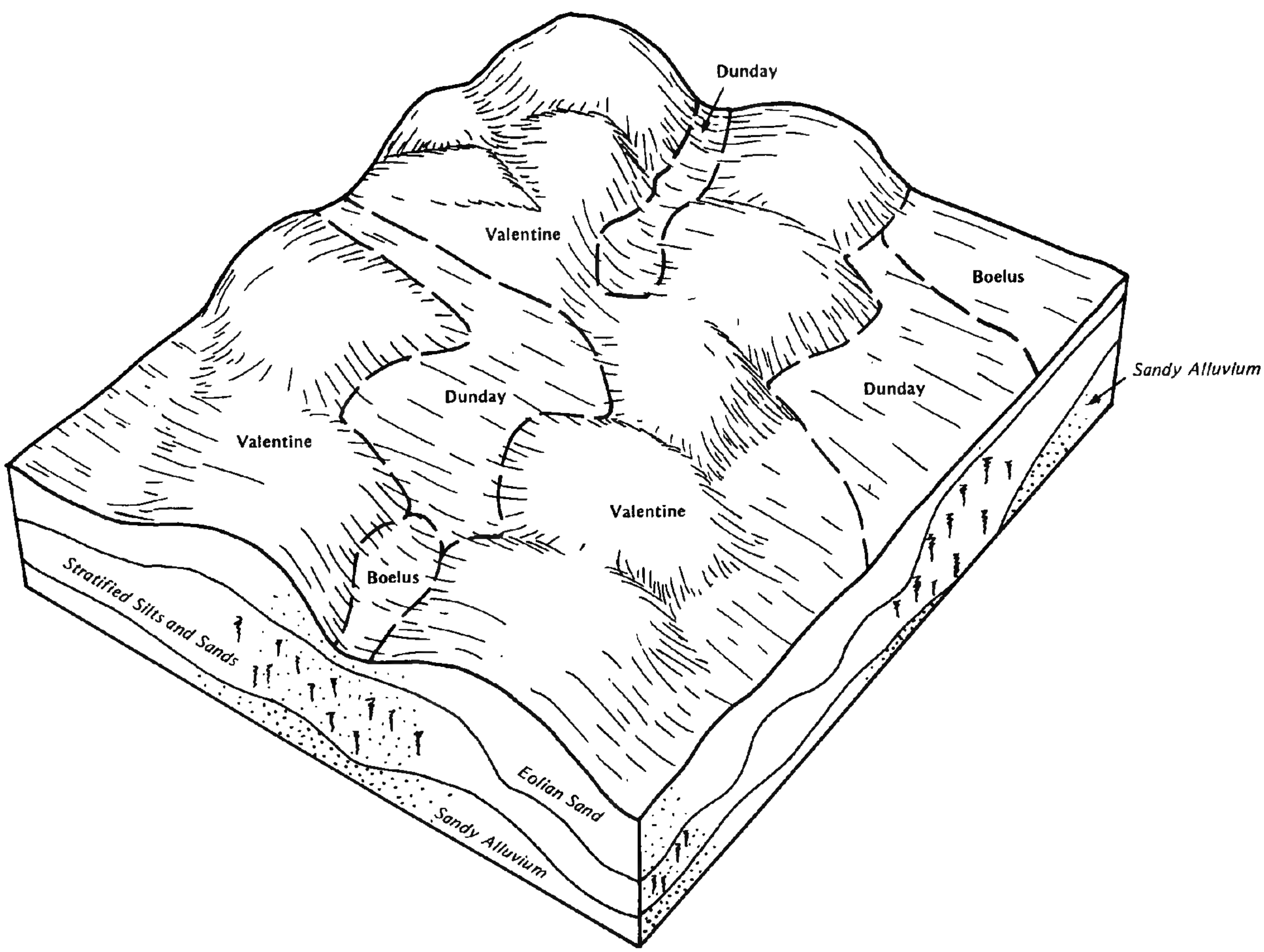

Figure 5.—Typical pattern of soils and parent material in the Valentine-Dunday association.

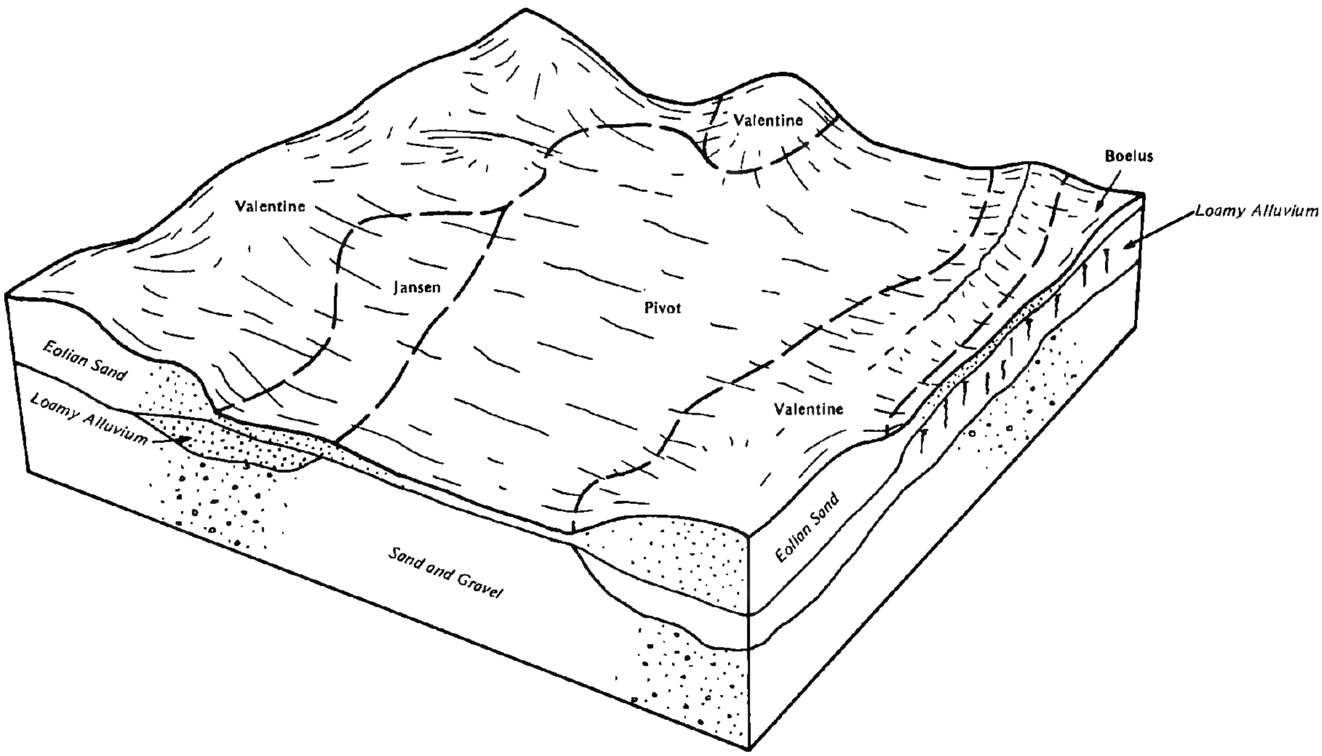

Figure 6.—Typical pattern of soils and parent material in the Pivot-Valentine association.

underlying material is light brownish gray and pale brown fine sand to a depth of more than 60 inches.

Of minor extent in this association are the Boelus, Els, Ipage, and Jansen soils. Boelus soils are in positions on the landscape similar to the Dunday soils. They are underlain by loamy material. Els soils are on lower positions on the landscape and are somewhat poorly drained. Ipage soils are on slightly lower positions on the landscape and are moderately well drained. Jansen soils have more clay in the subsoil and are moderately deep to coarse sand with gravel. They are generally in positions on the landscape similar to those of the Dunday soils.

Farms and ranches in this association are diversified, mainly combining cash-grain and livestock production. Many areas of this association are in native grass and are used for rangeland. Most of the soils are too droughty for dryfarming. Some areas are irrigated, mainly for corn and alfalfa. The soils are too sandy for gravity irrigation. Only sprinkler irrigation systems are suitable; light, frequent applications of irrigation water are needed to avoid leaching. Wells can usually be obtained for irrigation, livestock, and domestic uses.

Soil blowing is the main hazard in both cultivated and native-grass areas. Low available water capacity and low fertility are the major soil limitations. Soil blowing can be controlled by keeping the soil covered with grass, crops, or crop residue. Proper irrigation water management and proper application of fertilizers are concerns in management of cropland areas. Maintaining or improving the condition of the native grass is a concern of management. This can be accomplished by proper grazing use, by timely haying, and by rotational grazing and haying systems that change the order of use and rest each year.

5. Pivot-Valentine Association

Nearly level to strongly sloping, somewhat excessively drained and excessively drained, sandy soils that are moderately deep or deep over sand and gravel; on uplands

This association consists of soils on tablelands and uplands (fig. 6). These soils formed in sandy eolian material overlying deposits of sand or sand and gravel. Slopes range from 0 to 9 percent.

This association occupies about 30,980 acres, or about 5 percent of the county. It is about 43 percent Pivot soils, 22 percent Valentine soils, and 35 percent minor soils.

The Pivot soils are nearly level and very gently sloping and are somewhat excessively drained. They are

moderately deep over coarse sand. Typically, the surface layer is dark grayish brown, very friable loamy sand about 6 inches thick. The subsurface layer is grayish brown, very friable loamy sand about 7 inches thick. The next layer is brown, very friable sand about 14 inches thick. The underlying material is pale brown coarse sand to a depth of more than 60 inches.

The Valentine soils are deep, nearly level to strongly sloping, and excessively drained. Typically, the surface layer is dark grayish brown, loose fine sand about 9 inches thick. The next layer is brown, loose fine sand about 6 inches thick. The underlying material is pale brown fine sand to a depth of more than 60 inches.

Of minor extent in this association are the Boelus, Dunday, Els, Jansen, Libory, Meadin, and O'Neill soils. Boelus, Jansen, Meadin and O'Neill soils are in positions on the landscape similar to those of the Pivot soils. Boelus and Libory soils are underlain by loamy material. Libory soils are on slightly lower positions and are moderately well drained. Els soils are on lower positions and are somewhat poorly drained. Jansen and O'Neill soils have more clay in the subsoil. Meadin soils are shallow to coarse sand and gravelly material.

Farms and ranches in this association are diversified, mainly combining cash-grain and livestock production. About two-thirds of the acreage of this association is in native grass and is used for native hayland or rangeland. The rest of the acreage is irrigated cropland. These soils are too sandy for dry farming or for gravity irrigation, but they are well suited to sprinkler irrigation because they require frequent, light applications of water. Corn and alfalfa are the main crops grown under irrigation.

Soil blowing is the main hazard in areas of native grass and in cultivated areas. Soil limitations in this association are low available water capacity and low fertility. Soil blowing can be controlled by maintaining a cover of grass, crops, or crop residue on the surface of the soil. Irrigation water management is a major concern. Improving the organic matter content and maintaining the fertility of the soils are additional concerns of management.

Maintaining or improving the condition of the native grass is a concern in range management. This can be accomplished by proper grazing use, by timely deferment of grazing or haying, and by a rotational grazing system that changes the order of use and rest every year.

6. Pivot-O'Neill-Valentine Association

Nearly level to rolling, well drained to excessively drained, sandy and loamy soils that are moderately deep or deep over sand and gravel; on uplands

This association consists of soils on tablelands and uplands and in sandhills. These soils formed in sandy and loamy material. Slopes range from 0 to 17 percent.

This association occupies about 28,350 acres, or about 5 percent of the county. It is about 20 percent Pivot soils, 19 percent O'Neill soils, 16 percent Valentine soils, and 45 percent minor soils.

The Pivot soils are nearly level and very gently sloping and are somewhat excessively drained. They are moderately deep over coarse sand. Typically, the surface layer is dark gray, very friable loamy sand about 6 inches thick. The subsurface layer is dark grayish brown, very friable loamy sand about 9 inches thick. The next layer is brown, loose sand about 10 inches thick. The underlying material to a depth of more than 60 inches is pale brown and very pale brown, coarse sand that contains some gravel.

The O'Neill soils are nearly level to strongly sloping and are well drained. They are moderately deep over sand and gravelly sand. Typically, the surface layer is a dark grayish brown, very friable fine sandy loam about 7 inches thick. The subsurface layer is dark grayish brown, very friable fine sandy loam about 10 inches thick. The subsoil is about 15 inches thick. It is brown, very friable sandy loam in the upper part and pale brown, very friable sandy loam with gravel in the lower part. The underlying material to a depth of more than 60 inches is very pale brown sand in the upper part and gravelly sand in the lower part.

The Valentine soils are deep, gently sloping to rolling, and excessively drained. They formed in eolian sand. Typically, the surface layer is grayish brown, very friable fine sand about 12 inches thick. The next layer is brown, loose fine sand about 6 inches thick. The underlying material is pale brown sand to a depth of more than 60 inches.

Of minor extent in this association are the Boelus, Brunswick, Elsmere, Meadin, Simeon, Tassel, and Vetal soils. Boelus, Meadin, Simeon, and Vetal soils are in positions on the landscape similar to those of the Pivot soils. Boelus soils are underlain by loamy material. Brunswick soils are moderately deep to weathered sandstone. Elsmere soils are on lower positions on the landscape and are somewhat poorly drained. Meadin soils are shallow to coarse sand and gravel material. Simeon soils have a thin, light-colored surface layer and sand and coarse sand in the underlying material. Tassel soils are on the steeper breaks. They are shallow to weathered sandstone. Vetal soils have a dark surface layer more than 20 inches thick.

Farms and ranches in this association are diversified and mainly combine cash-grain and livestock production. Some dairy enterprises are operated in areas of this association. About one-half of the acreage of this association is used as cropland, and of this acreage, about one-half is irrigated. The rest of the area is in native grass, some of which is used for rangeland and some of which is harvested for hay. These soils are too sandy for gravity irrigation, but they are well suited to sprinkler irrigation because they require frequent, light applications of water. Corn and alfalfa are the main dryland crops.

Soil blowing, water erosion, and droughtiness are the main hazards in cultivated and native-grass areas of these soils. Low available water capacity and low fertility are limitations. Soil blowing and water erosion can be controlled by maintaining a cover of grass, crops, or crop residue on the surface. Irrigation water management is a major concern. Increasing the organic matter content and maintaining fertility are additional important concerns of management. Maintaining or improving the condition of the native grass is a concern in rangeland management. This can be accomplished by proper grazing use, by timely deferment of grazing or haying, and by a rotational grazing system that changes the order of use and rest each year.

Strongly sloping to very steep, sandy soils on breaks to the Niobrara River Valley

Only one association is in this group. These soils are deep, excessively drained, and sandy. They formed in eolian alluvial and outwash sands. These soils are used for rangeland. The main hazards are soil blowing and water erosion. The main concern of management is improving the range condition.

7. Simeon-Valentine Association

Deep, strongly sloping to very steep, excessively drained, sandy soils that formed in eolian, alluvial, and outwash sands; on breaks to the Niobrara River Valley

This association is on breaks to the Niobrara River Valley and its tributaries. Slopes range from 9 to 60 percent.

This association occupies about 15,853 acres, or about 2 percent of the county. It is about 53 percent Simeon soils, 44 percent Valentine soils, and 3 percent minor soils.

The Simeon soils are strongly sloping to steep and formed in sandy alluvium or outwash material. Typically, the surface layer is light brownish gray, loose sand about 4 inches thick. The next layer is pale brown, loose sand about 4 inches thick. The underlying material is white coarse sand to a depth of more than 60 inches.

The Valentine soils are strongly sloping to very steep and formed in eolian sand. Typically, the surface layer is grayish brown, loose sand about 9 inches thick. The underlying material is light gray sand to a depth of more than 60 inches. It is light brownish gray in the upper part and light gray in the lower part.

Of minor extent in this association are the Brunswick and Tassel soils. These soils are on the steeper side slopes or breaks. Brunswick soils are moderately deep to weathered sandstone and are well drained. Tassel soils are shallow to weathered sandstone and are somewhat excessively drained.

This soil association takes in parts of ranches that are mainly livestock enterprises engaging in cow-calf operations. The ranch headquarters are in adjoining soil associations. Nearly all of the acreage of this association is in native grass and is used for rangeland. The soils are generally too steep or too sandy to use as cropland under either dryland or irrigated management.

Soil blowing and water erosion are the main hazards in this association. Low available water capacity and low fertility of the soils are limitations. Soil blowing and water erosion can be controlled by management that improves the condition of the native grass. Such improvement can be accomplished by proper grazing use, along with a rotational grazing system that changes the order of use and rest each year. Lack of seasonal rainfall limits grass production in most years.

Nearly level and very gently sloping soils on uplands

Only one association is in this group. The soils are moderately deep or deep over coarse sand or gravelly coarse sand. They are somewhat excessively drained and excessively drained, sandy soils that formed in eolian and outwash material. Most of the acreage of this group of soils is used for rangeland, and in these areas, improving the range condition is the major concern of management. Some areas of this association are used for irrigated cropland. In these areas, soil blowing is a hazard, and conserving soil moisture and irrigation water management are the main concerns of management.

8. Pivot-Simeon Association

Nearly level and very gently sloping, somewhat excessively drained and excessively drained, sandy soils that are moderately deep or deep over sand and gravel; on uplands

This association consists of soils on tablelands. The soils formed in sandy eolian material overlying deposits of sand or gravel outwash. Slopes range from 0 to 3 percent.

This association occupies about l3,256 acres, or about 2 percent of the county. It is about 54 percent Pivot soils, 32 percent Simeon soils, and 14 percent minor soils.

The Pivot soils are nearly level and very gently sloping and are somewhat excessively drained. They are moderately deep over sand and coarse sand. Typically, the surface layer is dark gray, very friable loamy sand about 12 inches thick. The subsurface layer is dark grayish brown, very friable loamy sand about 6 inches thick. The next layer is dark grayish brown, very friable loamy sand about 5 inches thick. The underlying material to a depth of more than 60 inches is grayish brown sand in the upper part and pale brown coarse sand in the lower part.

The Simeon soils are deep, nearly level and very gently sloping, and excessively drained. Typically, the surface layer is dark grayish brown, very friable loamy sand about 4 inches thick. The subsurface layer is dark grayish brown, very friable sand about 5 inches thick. The next layer is brown, very friable sand about 10

inches thick. The underlying material is very pale brown sand to a depth of more than 60 inches.

Of minor extent in this association are the Meadin, O'Neill, and Valentine soils. Meodin and O'Neill soils are on the landscape positions similar to those of the Pivot soils. Meadin soils are shallow to coarse sand and gravel material. O'Neill soils have a heavier textured subsoil and are well drained. Valentine soils are higher on the landscape and do not contain coarse sand.

Farms and ranches in this association are mainly cow-calf livestock enterprises. Most of the acreage in this association is in native grass and is used for rangeland. Some areas of grass are harvested for native hay. These soils are generally too droughty for dryland farming. Some areas are irrigated by water that has been directed from running streams. Ground water supplies for irrigation are not reliable, but water from wells is generally available in sufficient quantities for livestock use. Corn and alfalfa are the main crops grown under irrigation.

Soil blowing and droughtiness are the main hazards. Low available water capacity and low fertility are soil limitations. Soil blowing can be controlled by maintaining a cover of grass, crops, or crop residue on the surface. Irrigation water management is a major concern. Improving the organic matter content of the soils and maintaining fertility are additional important concerns of management. Maintaining or improving the range condition is a concern of rangeland management. This can be accomplished by proper grazing use, by timely deferment of grazing or haying, and by a rotational grazing system that changes the order of use and rest each year.

Moderately steep to very steep, clayey soils on breaks to the Niobrara River Valley

Only one asssociation is in this group. These soils are moderately deep and shallow to bedded shale. They are used for rangeland. The main hazard is water erosion, and the main concern of management is improving the range condition.

9. Labu-Sansarc Association

Moderately deep and shallow, moderately steep to very steep, well drained, clayey soils that formed in material weathered from shale; on breaks to the Niobrara River Valley

This association consists of soils on shoulders and side slopes along the deeply entrenched Niobrara River and its tributaries (fig. 7). The soils in this association formed in material weathered from shale. Slopes range from 11 to 40 percent.

This association occupies about 6,501 acres, or about 1 percent of the county. It is about 47 percent Labu soils, 33 percent Sansarc soils, and 20 percent minor soils.

The moderately steep to steep Labu soils are moderately deep, well drained, clayey soils on side slopes along drainageways. Typically, the surface layer is dark grayish brown, friable silty clay about 6 inches thick. The subsoil is calcareous silty clay about 18 inches thick. It is friable and brown in the upper part and very firm and light yellowish brown in the lower part. The underlying material, about 9 inches thick, is light yellowish brown, calcareous shaly clay. Light yellowish brown, calcareous bedded shale begins at a depth of about 35 inches.

The steep to very steep Sansarc soils are shallow, well drained, clayey soils on upper side slopes and narrow ridgetops. Typically, the surface layer is grayish brown, calcareous, very friable silty clay about 4 inches thick. The underlying material, about 14 inches thick, is light brownish gray, calcareous shaly clay and very shaly clay. Light brownish gray, calcareous bedded shale is at a depth of 18 inches.

Of minor extent in this association are the Boel, Simeon, and Valentine soils. Boel, Simeon, and Valentine soils do not have shale within a depth of 40 inches. Boel soils are on bottom lands along the drainageways. They are sandy and are somewhat poorly drained. Simeon soils are higher on the landscape, contain more sand and gravel in the underlying material, and are excessively drained. Valentine soils are deep, sandy soils that are higher on the landscape and are excessively drained.

Most of the acreage of this association is in native grass and is used for rangeland. Soils in this association are generally too steep or too clayey to use as cropland under either dryland or irrigation management. Some of the less steeply sloping areas can be hayed. Some of the small areas on bottom lands and stream terraces can be used for irrigated cropland. Ground water supplies are not reliable. Wells dug in this area need to be deep, and they generally yield water of poor quality. Water for livestock is generally available from flowing streams. Some precipitation is caught and stored in stockwater ponds.

The farms and ranches in this association include soils in adjacent associations. These farms and ranches are mainly cow-calf livestock enterprises.

Maintaining or improving the condition of the range is a concern in rangeland management. This can be accomplished by proper grazing use, by timely deferment of grazing, and by a rotational grazing system that changes the order of use and rest each year. Water erosion and droughtiness are management concerns on the clayey soils, whether the soils are used as rangeland or as cropland. Maintaining an adequate vegetative cover and a ground mulch helps to prevent soil losses by erosion and improves the moisture supply by reducing runoff.

Figure 7.—Typical landscape in the Labu-Sansarc association. Labu soils are on the lower part of foot slopes and on the smoother, more rounded knolls of the hillsides. Sansarc soils are on the steeper and higher slopes.

Nearly level soils on bottom lands along the Niobrara River

Only one association is in this group. It is made up of deep, poorly drained and somewhat poorly drained, loamy and sandy soils that formed in alluvial material. Most areas are in native grass and are used for hayland or rangeland. Many areas are covered by trees and brush. A few areas of Boel soils are used for cropland and are generally irrigated. The main hazard on soils of this association is wetness caused by the high water table and flooding. The major concern of management is improving the condition of the native hayland and rangeland.

10. Barney-Boel Association

Deep, nearly level, poorly drained and somewhat poorly drained, loamy and sandy soils that formed in alluvium; on bottom lands

This association consists of soils formed in alluvium on bottom lands along the Niobrara River that are subject to flooding. Slopes range from 0 to 2 percent.

This association occupies about 3,021 acres, or about 1 percent of the county. It is about 71 percent Barney soils, 23 percent Boel soils, and 6 percent minor soils.

The Barney soils are deep, poorly drained soils. These soils are on the lowest part of the flood plain and are

frequently flooded. Typically, the surface layer is dark grayish brown, calcareous, friable fine sandy loam about 7 inches thick. The underlying material extends to a depth of more than 60 inches. It is very pale brown sand in the upper part and light gray coarse sand in the lower part. At a depth of 12 inches, the underlying material is interrupted by a layer of light brownish gray, stratified sandy loam about 5 inches thick.

The Boel soils are deep and somewhat poorly drained. They are occasionally flooded. Typically, the surface layer is gray, very friable loamy fine sand about 8 inches thick. The subsurface layer is dark gray, very friable loamy sand about 3 inches thick. The next layer is gray, loose mottled loamy sand about 7 inches thick. The underlying material is mottled and extends to a depth of 60 inches. It is pale brown sand in the upper part, light brownish gray, stratified very fine sandy loam in the middle part, and light gray coarse sand in the lower part.

Of minor extent in this association are the Labu soils. Labu soils are higher on the landscape and are well drained. They are moderately deep to bedded shale.

This soil association takes in parts of farms and ranches that have their headquarters in adjoining associations. These farms and ranches are diversified, combining mainly cash-grain and livestock production. Most of the acreage of this association is in native grass and is used as rangeland. Many areas are covered by trees and brush. The Barney soils are too wet to use as cropland. In the Boel soils, the high water table recedes to a depth of 4 to 6 feet in midsummer, and some of the larger areas of these soils are used for irrigated cropland. Other areas are dissected by streams or drainage channels, making them unsuitable for cultivation. Few farmsteads are in this association because of the wetness and flooding.

Soil blowing and lowland flooding are the main hazards in cultivated areas and in native-grass areas. Wetness from the high water table is a limitation in some areas. During wet seasons, the high water table interferes with both haying and tillage operations. Wetness causes the Boel soils to warm up slowly in spring and delays tillage operations. Because streambank erosion and other damage from flooding are hazards in places, dikes may be needed along areas used as cropland. A cover of crops or crop residue is needed to control soil blowing.

Maintaining or improving the condition of the native hayland or rangeland is a concern of management. This can be accomplished by proper grazing use, timely deferment of grazing, restriction on grazing during wet periods, and timely haying and by rotational grazing and haying systems that change the order of use and rest each year. In areas managed for cropland, maintaining fertility and controlling irrigation are concerns.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, O'Neill sandy loam, 0 to 2 percent slopes, is one of several phases in the O'Neill series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Els-Ipage complex, 0 to 3 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil Descriptions

Ba—Barney-Boel complex, channeled. This map unit consists of poorly drained Barney soils and somewhat poorly drained Boel soils on bottom lands along major drainageways. It is dissected by creek beds and stream channels that meander across the flood plain. Slopes range from 0 to 2 percent. The areas of Barney soils are on lower landscape positions and are frequently flooded. Boel soils are subject to occasional flooding, but the floodwater remains on the surface only a short time. The Barney soils make up about 50 to 60 percent of this complex, and the Boel soils make up 30 to 40 percent. The individual areas of the soils are so intricately mixed or so small that it is not practical to separate them at the scale used in mapping. The areas normally are long and narrow and 40 to 200 acres or more in size.

Typically, the Barney soils have a surface layer of dark grayish brown, calcareous, friable fine sandy loam about 7 inches thick. The mottled underlying material extends to a depth of more than 60 inches. It is very pale brown sand in the upper part and light gray coarse sand in the lower part. At a depth of 12 inches, the sandy underlying material is interrupted by a 5-inch layer of light brownish gray sandy loam that contains strata of grayish brown fine sand and loamy fine sand. In places, the dark surface layer is less than 7 inches thick. In a few places, dark buried layers are in the underlying material.

Typically, the Boel soils have a surface layer of dark grayish brown, very friable loamy sand about 11 inches thick. The next layer is grayish brown, very friable loamy sand about 4 inches thick. The underlying material extends to a depth of more than 60 inches. It is light brownish gray sand in the upper part; grayish brown, mottled, stratified loamy sand in the middle part; and light brownish gray coarse sand in the lower part. At a depth of 31 inches, the underlying material is interrupted by about 4 inches of dark grayish brown, mottled loam.

In some places, the surface is mantled by 6 to 24 inches of fine sand or sand that was deposited by floodwater. In some places, the surface layer is less than 10 inches thick. In a few places, the underlying material is gravelly coarse sand.

Included with this complex in mapping are small areas of Ipage, Labu, and Valentine soils. Ipage soils are moderately well drained, are on slightly higher positions on the landscape, and are not stratified. Labu soils are clayey throughout and are on higher, well drained positions. Valentine soils are excessively drained and are on higher positions. Included soils make up 10 to 15 percent of the complex.

In the upper part of Barney soils, permeability is moderately rapid, and in the lower part it is rapid. Permeability is rapid in Boel soils. The available water capacity is low in both soils. The organic matter content for both soils is moderately low. In most years, the seasonal high water table in the Barney soils ranges from the surface to within a depth of about 2 feet. The seasonal high water table in the Boel soils ranges from a depth of 1.5 feet in wet years to about 3.5 feet in dry years. It may recede to a depth of 5 to 6 feet during extended dry periods. Runoff is slow.

Most of the acreage of this complex is in native grass and is used mainly for grazing and as wildlife habitat. Trees, shrubs, and wetland grasses are in some areas.

The soils in this complex are unsuitable for cultivation. Most areas are managed with adjoining areas of range.

These soils are suited to rangeland. The natural plant community is mostly tall and mid grasses, grasslike plants, and various sedges. The Barney soils are dominated by prairie cordgrass, bluejoint reedgrass, and northern reedgrass. The Boel soils are dominated by big bluestem, little bluestem, indiangrass, switchgrass, and prairie cordgrass. In overgrazed areas or areas improperly harvested for hay, the soils may be dominated by timothy, redtop, foxtail barley, clover, sedges, and rushes.

These soils are not suited to sanitary facilities and building sites because of flooding. A suitable alternate site is needed. Digging in these soils should be limited to dry periods for easier operation of machinery and to avoid caving and water problems. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving. Constructing roads on suitable, well-compacted fill material above flood level and providing adequate side ditches and culverts help protect the roads from flood damage.

These soils are assigned to capability unit VIw-5, dryland, and windbreak suitability group 10. The Barney soils are in the Wetland range site, and the Boel soils are in the Subirrigated range site.

Bm—Boel loamy fine sand, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on bottom lands. It occurs along the Niobrara River Valley and other major drainageways. It is occasionally flooded, but floodwater remains on the surface for only short periods. Most areas of this soil are long and narrow and range from 20 to 160 acres in size.

Typically, the surface layer is gray, very friable loamy fine sand about 8 inches thick. The subsurface layer is dark gray, very friable loamy sand about 3 inches thick. The next layer is gray loamy sand about 7 inches thick. The underlying material is mottled and extends to a depth of more than 60 inches. It is pale brown sand in the upper part; light brownish gray, mottled very fine sandy loam in the middle part; and light gray coarse sand in the lower part. In a few places, near stream channels or the mouth of small drainageways, 6 to 24 inches of sandy or clayey overwash mantles the surface. In a few places, the dark surface layer is less than 10 inches thick.

Included with this soil in mapping are small areas of Barney and Labu soils. Barney soils are lower on the landscape and are poorly drained. The clayey Labu soils are on side slopes and are well drained. Included soils make up 10 to 20 percent of the map unit.

Permeability is rapid in this Boel soil, and the available water capacity is low. The organic matter content is moderately low. Runoff is very slow. The seasonal high water table ranges from a depth of 1.5 feet in wet years to about 3.5 feet in dry years. It normally recedes to a depth of 4 to 6 feet during midsummer. This soil is easily tilled throughout a wide range of moisture content.

About half the acreage of this soil is in native grass that is used for native hay or rangeland. The rest is used for corn or alfalfa production.

If this soil is dryfarmed, it is poorly suited to corn and small grains. Flooding may delay spring planting and limit production of small grains. Alfalfa is suited in areas where the water table is not too high. This soil is difficult to work in spring because of wetness caused by the high water table. Alfalfa and other close-growing crops eliminate the need for working this soil in spring and also protect it against soil blowing when the surface is dry. The hazard of soil blowing can be reduced by use of conservation tillage, such as stubble-mulch tillage, and a cropping system that keeps the soil covered with crop residue most of the time. Returning crop residue to the soil and adding barnyard manure increase the organic matter content and improve fertility.

This soil is poorly suited to irrigation. Corn and alfalfa are suitable crops if the soil is irrigated and flooding is controlled. Sprinkler irrigation is the most suitable method of applying irrigation water; applications of water need to be light and frequent. Excessive irrigation leaches plant nutrients below the root zone. Wetness can be controlled by the use of open drains or tile drains where suitable outlets are available. Stubble-mulch tillage and the use of winter cover crops are needed to control soil blowing.

This soil is suited to rangeland and native hay, and such use is effective in controlling soil blowing. The natural plant community is mostly tall and mid grasses and grasslike plants dominated by big bluestem, little bluestem, indiangrass, switchgrass, prairie cordgrass, and various sedges. If the plants are overgrazed or improperly harvested for hay, the soil may be dominated by timothy, redtop, clovers, ironweeds, sedges, and rushes.

This soil is suited to planting trees in windbreaks. Only the trees and shrubs that are tolerant of a moderately high water table are suited. Establishment of seedlings and cultivation between rows can be a problem during wet years. The abundant and persistent herbaceous vegetation that grows in the tree rows is a concern because it competes with the trees. Weeds and undesirable grasses can be controlled by cultivating between the rows with conventional equipment and the timely use of herbicides.

This soil is not suited to use as a septic tank absorption field or as a building site because of flooding. A suitable alternate site is needed. Sewage lagoons need to be lined or sealed to prevent seepage and need to be diked for protection from flooding. Sewage lagoons need to be constructed on fill material to raise the bottom of the lagoon to a sufficient height above the seasonal high water table. Digging should be limited to dry periods for easier operation of machinery and to avoid caving and water problems. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving. Constructing roads on suitable, well-compacted fill material above flood level and providing adequate side ditches and culverts help to protect the roads from flood damage.

This soil is in capability units IVw-5, dryland, and IVw-11, irrigated, the Subirrigated range site, and windbreak suitability group 2S.

BpB—Boelus loamy sand, 0 to 3 percent slopes. This deep, nearly level and very gently sloping, well drained soil is on uplands. Areas range from 15 to 150 acres in size.

Typically, the surface layer is dark gray, very friable loamy sand about 7 inches thick. The subsurface layer, about 7 inches thick, is grayish brown, very friable loamy sand. The subsoil is about 23 inches thick. The upper part is brown, very friable loamy fine sand, and the lower part is brown and pale brown, friable very fine sandy loam. The underlying material is very pale brown very fine sandy loam to a depth of more than 60 inches. In some places, the dark surface layer is less than 10 inches thick, and in some places, the surface layer is sandy loam or loamy fine sand. In some areas, the sandy material is either less than 20 inches thick or more than 40 inches thick over the loamy material.

Included with this soil in mapping are small areas of Dunday, Jansen, Libory, Pivot, and Valentine soils. Dunday and Valentine soils are higher on the landscape than this Boelus soil and do not have loamy underlying material. Jansen and Pivot soils are in lower positions and are underlain by coarse sand or gravelly coarse sand. Libory soils are moderately well drained and are on lower positions on the landscape. Also included are places where the loamy material is exposed at the surface. Included soils make up 10 to 15 percent of the map unit.

In this Boelus soil, permeability is rapid in the upper part and moderate in the loamy underlying material. The available water capacity is high. The organic matter content is moderately low. Runoff is slow. This soil is easily tilled when moist or dry.

About half the acreage of this soil is farmed, and the rest is in native grass. A large acreage of the cropland is irrigated.

If this soil is dryfarmed, it is suited to corn, small grains, and alfalfa. Small grains and first-cutting alfalfa generally are the most dependable crops because they grow and mature in spring when the rainfall is plentiful. This soil is highly susceptible to soil blowing. A cropping system that keeps the soil covered with crop residue most of the time reduces soil blowing, conserves soil moisture, and helps maintain the organic matter content and fertility. Adding barnyard manure increases the organic matter content and improves fertility.

If this soil is irrigated, it is suited to corn, alfalfa, and introduced grasses. Sprinkler irrigation is the method best suited to this soil because light, frequent applications of irrigation water are needed. Returning crop residue to the soil increases the organic matter content. Keeping the soil covered with crops, grass, or crop residue helps reduce soil blowing and conserve soil moisture.

This soil is suited to rangeland, and this use is very effective in controlling soil blowing and water erosion. The natural plant community is dominated by sand bluestem, little bluestem, prairie sandreed, switchgrass, and needleandthread. If the plants are overgrazed, the soil may be dominated by Scribner panicum, blue grama, sand dropseed, and perennial weeds.

This soil is suitable for planting trees and shrubs in windbreaks. Only the trees and shrubs tolerant of sandy, somewhat droughty conditions are suited. Insufficient moisture and severe soil blowing are the principal hazards in establishment of trees. Irrigation can provide supplemental moisture during dry periods. Soil blowing can be controlled by maintaining strips of sod or other vegetation between the rows. The weeds compete with the trees for moisture. Weeds and grasses can be controlled by cultivation or by using appropriate herbicides.

This soil generally is suited to use as a septic tank absorption field and as a site for shallow excavations. Sewage lagoons need to be lined or sealed to prevent seepage. Foundations for buildings need to be

strengthened and backfilled with coarse materials to prevent damage caused by the shrinking and swelling of the soil. Roads and streets need to be designed so that the surface pavement and subbase are thick enough to compensate for the low strength of the soil material. If coarse-grained material is used for subgrade or base material, better performance is insured.

This soil is assigned to capability units IIIe-6, dryland, and IIIe-10, irrigated, the Sandy range site, and windbreak suitability group 5.

BrD—Brunswick-Tassel loamy sands, 3 to 11 percent slopes. This complex consists of gently sloping to strongly sloping, well drained soils on ridges and side slopes along drainageways. It is about 50 to 60 percent Brunswick loamy sand and 20 to 30 percent Tassel loamy sand. The moderately deep Brunswick soil generally is on the smooth, lower side slopes. The shallow Tassel soil is on upper ridges and side slopes. The individual areas of these soils are so intricately mixed or so small that it is not practical to separate them at the scale used in mapping. Areas of this complex range from 20 to more than 200 acres in size.

Typically, the Brunswick soil has a dark grayish brown, very friable loamy sand surface layer about 4 inches thick. The subsoil is friable fine sandy loam about 15 inches thick. The upper part is grayish brown, and the lower part is light gray. The underlying material, about 5 inches thick, is light gray loamy fine sand. White, soft sandstone is at a depth of about 24 inches. In places, the surface layer is fine sandy loam. In some places, the subsoil is sandy clay loam or silt loam. In some places, the soft sandstone is below a depth of 40 inches.

Typically, the Tassel soil has a dark grayish brown, very friable, calcareous loamy sand surface layer about 6 inches thick. The underlying material, about 6 inches thick, is grayish brown, calcareous fine sandy loam. White, calcareous, soft sandstone is at a depth of about 12 inches. In places, the surface layer is sandy loam or loamy fine sand.

Included with these soils in mapping are small areas of Labu, Meadin, O'Neill, Sansarc, Simeon, and Valentine soils. Labu soils, on the breaks along drainageways, are moderately deep to bedded shale. Meadin and O'Neill soils, which are on landscape positions similar to or slightly higher than those of Brunswick and Tassel soils, are underlain by gravelly coarse sand or coarse sand with gravel. Sansarc soils are on breaks and are shallow to bedded shale. Simeon and Valentine soils are sandy throughout and are on hummocky or level areas. Included soils make up 10 to 15 percent of the complex.

In the Brunswick and Tassel soils, permeability is moderately rapid. The available water capacity is low in the Brunswick soil and very low in the Tassel soil. Both soils are low in organic matter content. Surface runoff is medium to rapid.

About two-thirds of this map unit is cropland used for alfalfa hay. Some of the acreage is now irrigated and used for corn and grain sorghum. The rest is in native grass used for grazing.

If dryfarmed, the soils in this complex are poorly suited to corn, grain or forage sorghum, small grains, and alfalfa. Soil blowing and water erosion are hazards. Such practices as stubble-mulch tillage and keeping crops or crop residue on the surface most of the time help to reduce erosion and conserve moisture. Contour farming helps to prevent water erosion. Adding barnyard manure to the soil improves fertility. Wind stripcropping reduces soil blowing.

If irrigated, these soils are poorly suited to corn, grain or forage sorghum, alfalfa, and introduced grasses. The soils are best suited to sprinkler irrigation. Frequent, light applications of irrigation water are needed. Contour farming along with disking and other tillage practices that keep the crop residue at the surface help control erosion, conserve moisture, and increase the water intake rate. Adding barnyard manure to the soil helps maintain fertility and increase the organic matter content.

This complex is suited to rangeland, and this use is effective in controlling soil blowing and water erosion. The natural plant community is mostly tall and mid grasses. The Brunswick soil is dominated by sand bluestem, little bluestem, needleandthread, and blue grama. The Tassel soil is dominated by sand bluestem, little bluestem, prairie sandreed, big bluestem, and needleandthread. In overgrazed areas of Brunswick soil, blue grama, sand dropseed, Scribner panicum, and perennial weeds may be dominant. In areas of Tassel soil that are overgrazed, big bluestem or sand bluestem and little bluestem decrease, and sideoats grama, blue grama, prairie sandreed, and plains muhly increase. If overgrazing continues for many years, the less desirable woody plants increase, including bur oak, ponderosa pine, sumac, buckbrush, and soapweed. Brush management may be needed to control the woody plants.

The Brunswick soil is suited to trees and shrubs planted in windbreaks. The Tassel soil is unsuitable for windbreak plantings because of a shallow root zone and low available water capacity. These soils are so intermingled that they cannot be managed separately. Before planning a windbreak, onsite investigations are needed. Insufficient rainfall is the main hazard to seedling establishment. Only drought-tolerant species should be planted. Moisture competition from weeds and grasses can be controlled by cultivation between the rows with conventional equipment. Careful use of herbicides or hoeing by hand can control weeds in the row. Use of herbicides may cause problems due to leaching. Irrigation can provide supplemental moisture during droughts.

In areas of the Brunswick soils, raising or mounding a septic tank absorption field site with suitable fill material

increases the filtering capacity of the soil. The Tassel soil is not suited to sanitary facilities because of the slope and shallow depth to bedrock. A suitable alternate site is needed. Sewage lagoons can be constructed on the Brunswick soil if, after excavation, the bottom of the lagoon is sealed to prevent seepage. Grading is required to modify the slope and shape the lagoon. On the Brunswick soil, the walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving. The soft bedrock generally can be easily excavated for construction of dwellings with basements or for buildings that have deep foundations. Buildings should be designed to accommodate the slope, or the soil can be graded. Damage to roads and streets by frost action can be reduced by providing good surface drainage.

These soils are assigned to capability units IVe-3, dryland, and IVe-9, irrigated. The Brunswick soil is in the Sandy range site and windbreak suitability group 7. The Tassel soil is in the Shallow Limy range site and windbreak suitability group 10.

BtF—Brunswick-Tassel fine sandy loams, 11 to 40 percent slopes. This complex consists of moderately steep to very steep soils on side slopes along drainageways. It is about 45 to 55 percent Brunswick fine sandy loam and 25 to 35 percent Tassel fine sandy loam. Ledges of quartzite and sandstone bedrock crop out. The well drained Brunswick soil generally is on the smooth lower side slopes of less than 30 percent and is moderately deep over soft sandstone. The somewhat excessively drained Tassel soil is on the upper side slopes and is shallow to soft sandstone. The individual areas of these soils are so intricately mixed or so small that it is not practical to separate them at the scale used in mapping. Areas of this complex range from 20 to more than 200 acres in size.

Typically, the Brunswick soil has a dark grayish brown, very friable fine sandy loam surface layer about 6 inches thick. The subsoil is very friable fine sandy loam about 14 inches thick. The upper part is grayish brown, and the lower part is light brownish gray. The underlying material, about 4 inches thick, is light olive gray loamy fine sand. Light gray, soft sandstone is at a depth of about 24 inches. In places, the surface layer is loamy sand or loamy fine sand. In some places, the subsoil is sandy clay loam or clay loam. In some places, the soft sandstone is below a depth of 40 inches.

Typically, the Tassel soil has a dark grayish brown, very friable fine sandy loam surface layer about 4 inches thick. The underlying material, about 4 inches thick, is grayish brown fine sandy loam. White, calcareous, soft sandstone is at a depth of about 8 inches. In places, the surface layer is loamy fine sand, loamy sand, or sandy loam.

Included with this complex in mapping are small areas of rock outcrop and of Labu, O'Neill, Simeon, and Valentine soils. Labu soils are on the breaks along drainageways and are moderately deep to bedded shale. O'Neill soils are on landscape positions similar to those of Brunswick soils and are underlain by gravelly coarse sand. Simeon and Valentine soils are sandy throughout and are on hummocky or level landscape. Included soils make up to 15 percent of the complex.

In the Brunswick and Tassel soils, permeability is moderately rapid. The available water capacity is low in the Brunswick soil and very low in the Tassel soil. Both soils have low organic matter content. Surface runoff is rapid.

Nearly all the acreage is in native grass or is covered with bur oak or redcedar trees and used as rangeland. The soils in this complex are not suited to cultivation; they are too steep and too droughty. Water erosion is a severe hazard in cultivated or overgrazed areas.

These soils are suited to rangeland use, which is effective in controlling soil blowing and water erosion. The natural plant community is mostly tall and mid grasses. On the Brunswick soil, sand bluestem, little bluestem, prairie sandreed, switchgrass, and blue grama are dominant. On the Tassel soil, sand bluestem, little bluestem, prairie sandreed, and needleandthread are dominant. In overgrazed areas, the Brunswick soils may be dominated by sand dropseed, Scribner panicum, blue grama, and numerous annual and perennial weeds. On overgrazed areas of the Tassel soil, big bluestem or sand bluestem and little bluestem decrease, and sideoats grama, hairy grama, blue grama, prairie sandreed, and plains muhly increase. If overgrazing continues for many years, the less desirable woody plants increase, including bur oak, ponderosa pine, sumac, buckbrush, and small soapweed. Brush management may be needed to control the woody plants.

The soils in this complex generally are unsuitable for trees planted in windreaks; however, onsite investigation may help to locate small areas suitable for planting. The soils are too steep and too droughty for good growth of trees and shrubs. Some areas can be used for recreation or wildlife plantings of tolerant trees or shrubs if they are hand planted or other special approved practices are used.

These soils generally are not suitable for sanitary facilities because of the steep slope and shallow depth to bedrock. A suitable alternate site is needed. Cuts and fills generally are needed to provide a suitable grade for roads.

These soils are assigned to capability unit VIs-4, dryland, and windbreak suitability group 10. The Brunswick soil is in the Sandy range site, and the Tassel soil is in the Shallow Limy range site.

DuB—Dunday loamy fine sand, 0 to 3 percent slopes. This deep, nearly level and very gently sloping,

well drained soil is on uplands. Areas range from 25 to 320 acres or more in size.

Typically, the surface layer, about 11 inches thick, is dark grayish brown, very friable loamy fine sand. The next layer is grayish brown, very friable loamy fine sand about 11 inches thick. The underlying material is light brownish gray and pale brown fine sand to a depth of more than 60 inches. In some places, the upper part of the surface layer is sandy loam or fine sand. In some places, the dark surface soil is more than 20 inches thick. In some areas, coarse sand is at a depth of 20 to 40 inches.

Included with this soil in mapping are small areas of Boelus, Elsmere, and Valentine soils. Boelus soils are in positions on the landscape similar to those of the Dunday soils. They have loamy underlying material. The somewhat poorly drained Elsmere soils are lower on the landscape. Valentine soils are higher on the landscape and have a thinner surface layer. Included soils make up 10 to 20 percent of this map unit.

In this Dunday soil, permeability is rapid. The available water capacity is low, and the organic matter content is moderately low. The water intake rate is very high. Runoff is very slow. This soil is easily worked throughout a wide range of moisture content.

A large acreage of this soil is farmed, and much of it is irrigated. The rest of the acreage is in native grass used for range.

If this soil is dryfarmed, it is poorly suited to corn, grain or forage sorghum, alfalfa, small grains, and introduced grasses. Soil blowing is a serious hazard. Returning crop residue to the soil and using barnyard manure help to increase the organic matter content and improve fertility. Planting rye or rye and vetch between corn rows in the fall provides winter pasture and a winter cover crop to reduce soil blowing. Stripcropping can also be used to control soil blowing. The low available water capacity makes this soil droughty.

If this soil is irrigated, it is suited to corn, grain or forage sorghum, alfalfa, and introduced grass. Sprinkler irrigation is the only method suited to this soil. Applications of water should be light and frequent to prevent leaching of plant nutrients below the root zone. Soil blowing is a severe hazard in cultivated areas. A cropping system that keeps the soil covered with crops, grass, or crop residue helps reduce soil blowing and conserves moisture. All crop residue should be returned to the soil.

This soil is suited to rangeland, which is very effective in controlling soil blowing and water erosion. The natural plant community is dominated by sand bluestem, little bluestem, prairie sandreed, switchgrass, and needleandthread. If the site is overgrazed or improperly harvested for hay, the soil may be dominated by Scribner panicum, blue grama, sand dropseed, and numerous annual and perennial weeds.

This soil is suitable for planting trees and shrubs in windbreaks. Only trees and shrubs tolerant of sandy, somewhat droughty soil are suited. Insufficient moisture and severe soil blowing are the principal limitations to establishment of trees. Irrigation can provide moisture during dry periods. Soil blowing can be prevented by maintaining strips of sod or other vegetation between the rows. Weeds and undesirable grasses can be controlled by cultivating with conventional equipment or by using appropriate herbicides.

This soil generally is suited to use as a site for dwellings, roads, and streets. It is limited for use as septic tank absorption fields by its poor filtering capacity, which may result in pollution of nearby water supplies. Sewage lagoons should be lined and sealed to prevent seepage. The walls of excavations can be temporarily shored to prevent sloughing or caving.

This soil is in capability units IVe-5, dryland, and IIIe-11, irrigated, the Sandy range site, and windbreak suitability group 5.

Eo—Els loamy sand, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on bottoms of valleys and in low sandhill areas. Flooding is rare. Areas range from 25 to 500 acres in size.

Typically, the surface layer is gray, loose loamy sand about 4 inches thick. The subsurface layer is dark gray, very friable loamy fine sand about 4 inches thick. Below this layer is light brownish gray, friable loamy sand about 6 inches thick. The underlying material to a depth of 60 inches or more is light brownish gray, mottled sand in the upper part; light gray, mottled sand in the middle part; and light brownish gray, mottled sand in the lower part. In places, the dark surface layer is more than 10 inches or less than 6 inches thick. In some places, the surface layer is fine sand. In some places, loamy strata are below a depth of 40 inches.

Included with this soil in mapping are small areas of Ipage, Tryon, and Valentine soils. The Ipage soils are on the higher ridges and are moderately well drained. Tryon soils occupy the low areas and drainageways and are poorly drained and very poorly drained. The Valentine soils are on the higher parts of the landscape and are better drained. Included soils make up 10 to 15 percent of the map unit.

Permeability is rapid in this Els soil. The available water capacity is low. The organic matter content is moderately low. Runoff is very slow. The water intake rate is very high. The seasonal high water table ranges from a depth of about 1.5 feet in wet years to about 3.0 feet in dry years.

Most of the acreage of this soil is in rangeland and is used for native hay production or range. A small acreage is used as cropland, and most of the cropland is irrigated.

If dryfarmed, this soil is poorly suited to corn and alfalfa. The acreage in small grains is limited because

the water table is highest in the spring. Soil wetness delays planting in spring and may prevent cultivation in the wettest season. During dry parts of the year, the water table can be beneficial to grasses and growing crops; however, it may drown out corn and alfalfa in some places. Soil blowing is a hazard in cultivated areas. Soil blowing can be controlled by using stubble-mulch tillage, returning crop residue to the soil, planting winter cover crops, and using close-growing crops. Barnyard manure is needed on this soil to increase the organic matter content and improve fertility.

If this soil is irrigated, it is poorly suited to corn and alfalfa. Sprinkler irrigation is the most suitable method on this soil. Irrigation water needs to be applied frequently in small quantities to prevent waterlogging of the soil and deep leaching of nutrients. Tiling normally is not required for irrigation, but the water table is a problem during wet periods. Soil blowing can be controlled by using stubble-mulch tillage and crop residue and by planting close-growing crops.

This soil is suited to rangeland and native hay. The natural plant community is mostly tall and mid grasses and grasslike plants dominated by big bluestem, little bluestem, indiangrass, switchgrass, prairie cordgrass, and various sedges. If the plants are overgrazed or improperly harvested for hay, the soil may be dominated by timothy, redtop, foxtail barley, ironweed, clover, sedges, and rushes.

If this soil is used for native hay, mowing needs to be regulated so that the grasses remain vigorous and keep their place in the meadow. In order to allow for carbohydrate storage in the grasses, mowing should be avoided between boot stage and seed maturity, especially on meadows that are hayed about the same time each year. The meadow should be mowed before the dominant grasses reach the boot stage. Additions of nitrogen and phosphate fertilizers can increase hay production (*5*). After frost, range animals usually can graze without damaging meadows if the proper stocking rate is used.

This soil is suitable for planting trees and shrubs in windbreaks if the species selected can tolerate occasional wetness. Establishing the trees and cultivating between the rows can be a problem in wet seasons. Tree planting can be delayed until the soil dries out. The abundant and persistent herbaceous vegetation that grows in the tree rows is a concern because it competes with the trees. Weeds and grasses can be controlled by cultivation or by using appropriate herbicides.

This soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity may result in pollution of ground water. Sewage lagoons need to be lined or sealed to prevent seepage. Sewage lagoons need to be constructed on fill material to raise the bottom of the lagoon to a sufficient height above the seasonal high water table. The walls or sides of shallow excavations can be shored to prevent sloughing or caving. Digging should be limited to dry periods to reduce water problems. Sites for dwellings and other buildings should be raised with well-compacted fill material because of the high water table and the flood hazard. Constructing roads on suitable, well-compacted fill material and providing adequate side ditches and culverts help protect the roads from flood damage and wetness. Road damage caused by frost action can be reduced by providing good surface drainage and by using a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is in capability units IVw-5, dryland, and IVw-11, irrigated, the Subirrigated range site, and windbreak suitability group 2S.

EpB—Els-Ipage complex, 0 to 3 percent slopes. This complex consists of deep, nearly level and very gently sloping Els and Ipage soils on bottoms of upland valleys within or adjacent to the sandhills. The somewhat poorly drained Els soils are in swales that are rarely flooded. The moderately well drained Ipage soils are on low sandy ridges that are not flooded. Areas range from 10 to 1,000 acres in size. About 55 to 65 percent of this complex is Els soils, and 25 to 35 percent is Ipage soils. The individual areas of these soils are so intricately mixed or so small that it is not practical to separate them at the scale used in mapping.

Typically, the Els soils have a surface layer of grayish brown, very friable loamy sand about 9 inches thick. Below this layer is light brownish gray, very friable fine sand about 5 inches thick. The underlying material to a depth of more than 60 inches is mottled fine sand. It is pale brown in the upper part and very pale brown in the lower part. In places, the dark surface layer is 10 inches or more thick. In a few places, loamy material or gravelly coarse sand is below a depth of 40 inches.

Typically, the Ipage soils have a surface layer of grayish brown, very friable fine sand about 5 inches thick. The next layer is brown, loose fine sand about 11 inches thick. The underlying material to a depth of more than 60 inches is fine sand. It is light brownish gray and pale brown in the upper part, light gray in the middle part, and pale brown in the lower part. Mottles are below a depth of 24 inches. In some places, gravelly coarse sand is between depths of 20 and 40 inches.

Included with this complex in mapping are small areas of Dunday, Libory, Loup, Tryon, and Valentine soils. Barney, Loup, and Tryon soils are on lower parts of the landscape and are poorly drained and very poorly drained. Dunday, Libory, and Loup soils have a thicker dark surface layer. Dunday and Valentine soils are on the higher hummocky positions and are better drained. Libory soils are on similar positions and have a loamy

subsoil. Included soils make up 10 to 15 percent of the complex.

In the Els and Ipage soils, permeability is rapid. Both soils have low available water capacity. The organic matter content is moderately low in the Els soils and low in the Ipage soils. Runoff is slow to very slow. The water intake rate is very high. The seasonal high water table in the Els soils ranges from a depth of about 1.5 feet in wet years to about 3.0 feet in dry years. The seasonal high water table in the Ipage soils ranges from a depth of about 3 feet in wet years to about 6 feet in dry years.

Most of the acreage is in native grass and is used for range or native hayland. The rest of the acreage is mostly irrigated cropland.

This complex is unsuited to dryfarming because of droughtiness and the hazard of soil blowing on the Ipage soils if the grass cover is removed.

If they are irrigated, the soils in this complex are suited to corn, alfalfa, and introduced grasses. They are too sandy for the gravity method of irrigation but can be sprinkler irrigated. Soil blowing is a severe hazard if the surface is not adequately protected. Wetness is a concern in some of the low areas, and artificial drainage may be needed. Soil blowing can be controlled by using winter cover crops and close-growing crops and by leaving crop residue on the surface.

These soils are suited to rangeland or native hay. This use is effective in controlling soil blowing. The natural plant community is mostly tall and mid grasses, grasslike plants, and various sedges. The Els soils are dominated by big bluestem, little bluestem, indiangrass, switchgrass, and prairie cordgrass. The Ipage soils are dominated by sand bluestem, little bluestem, switchgrass, and prairie sandreed. In overgrazed areas of Els soils or in areas that are improperly harvested for hay, timothy, redtop, foxtail barley, ironweed, clover, sedges, and rushes may become dominant. In overgrazed areas of Ipage soils or areas improperly harvested for hay, the soil may be dominated by blue grama, hairy grama, sand dropseed, prairie sandreed, Scribner panicum, and numerous annual and perennial weeds.

Mowing needs to be regulated so that the grasses remain vigorous when these soils are used for native hayland. The meadow should be mowed before the dominant grass species reach the boot stage. Mowing should be avoided between boot stage and seed maturity. After frost and during winter, range animals can graze without damaging meadows if the proper stocking rate is used.

The soils in this complex are suited to trees in windbreaks if soil blowing is controlled. The species selected for planting on the Els soils must be those that can tolerate occasional wetness. Establishment of seedlings can be difficult on Els soils during wet years. Tillage and tree planting operations should be delayed until the soil dries out. The Ipage soils are so loose that trees have to be planted in shallow furrows and not cultivated. Soil blowing can be controlled by maintaining strips of sod or other vegetation between the rows. Young seedlings may be damaged by sand blasting during high winds and can be covered by drifting sand. The abundant and persistent herbaceous vegetation that grows on this site can be controlled by cultivation or by appropriate herbicides.

If these soils are used for septic tank absorption fields, care should be taken that seepage does not contaminate the ground water. They readily absorb effluent from septic tank absorption fields but do not adequately filter the effluent. Sewage lagoons need to be lined or sealed to prevent seepage. Sewage lagoons need to be constructed on fill material to raise the bottom of the lagoon to a sufficient height above the water table. Walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving. Digging in the Els soils should be limited to dry periods for easier operation of machinery and to reduce water problems. The Ipage soils generally are suited to use for dwellings without basements. If dwellings and other buildings are constructed on the Els soils and dwellings with basements on the Ipage soils, well-compacted fill material is needed to raise the site above the seasonal high water table. Raising the site also provides protection against floodwater on the Els soil. Road damage caused by frost action can be reduced by using good surface drainage and by using a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage. Constructing roads on suitable, well-compacted fill material and providing adequate side ditches and culverts help to protect the roads from flooding and wetness on the Els soils.

These soils are assigned to capability units VIe-5, dryland, and IVe-12, irrigated. The Els soils are in the Subirrigated range site and windbreak suitability group 2S. The Ipage soils are in the Sandy Lowland range site and windbreak suitability group 7.

ErC—Els-Ipage-Tryon loamy sands, 0 to 6 percent slopes. This complex consists of somewhat poorly drained Els soil, moderately well drained Ipage soil, and poorly drained Tryon soil. The Els soil is deep and nearly level and very gently sloping and occurs in valleys of the sandhills. The Ipage soil is deep and nearly level to gently sloping and occupies low, hummocky slopes. The Tryon soil is deep and nearly level and occupies bottom lands. Els and Tryon soils are rarely flooded. Areas of this complex range from 60 to 500 acres in size. About 35 to 45 percent of the complex is Els loamy sand, 30 to 40 percent is Ipage loamy sand, and 20 to 30 percent is Tryon loamy sand. The individual areas of these soils are so intricately mixed or so small that it is not practical to separate them at the scale used in mapping.

Typically, the Els soil has a surface layer that is dark grayish brown, very friable loamy sand about 6 inches

thick. The next layer is brown, very friable fine sand about 5 inches thick. The underlying material to a depth of 60 inches is sand. It is pale brown in the upper part and mottled and very pale brown in the lower part. In a few places, the dark surface layer is less than 6 inches thick or thicker than 10 inches.

Typically, the Ipage soil has a surface layer that is dark gray, very friable loamy sand about 8 inches thick. The next layer is grayish brown, very friable loamy sand about 7 inches thick. The underlying material to a depth of 60 inches is pale brown fine sand in the upper part and light gray, mottled sand in the lower part. In a few places, the dark surface layer is thicker than 10 inches.

Typically, the Tryon soil has a surface layer that is very dark gray, loose loamy sand about 3 inches thick. The next layer is mottled, dark grayish brown, loose fine sand about 4 inches thick. The underlying material to a depth of 60 inches is mottled, grayish brown fine sand. In a few places, the dark surface layer is more than 10 inches thick. Also, in some areas, the soils are very poorly drained and ponded during the spring and early summer.

Included with this complex in mapping are small areas of Marlake and Valentine soils. The Marlake soils have a stratified surface soil and are on the lowest part of the landscape. These soils are ponded during much of the growing season. The Valentine soils are on high, hummocky topography and are excessively drained. Also included are small areas of alkali soils. Included soils make up 5 to 10 percent of the complex.

In the Els, Ipage, and Tryon soils, permeability is rapid and the available water capacity is low. The organic matter content is moderately low in the Els soil, low in the Ipage soil, and high in the Tryon soil. Runoff is slow or very slow. The seasonal high water table in the Els soil ranges from a depth of 1.5 feet in wet years to 3.0 feet in dry years. The seasonal high water table in the Ipage soil ranges from a depth of about 3 feet in wet years to about 6 feet in dry years. The seasonal high water table in the Tryon soil is at or near the surface in wet years and drops to a depth of about 1.5 feet in dry years.

Most of the acreage of this complex is in native grass and is used as rangeland. Some areas are used as native hayland.

The soils in this unit are unsuitable for crops because of the hazard of soil blowing on the Els and Ipage soils and ponding caused by the seasonal high water table in areas of the Tryon soil.

These soils are suited to rangeland and native hay, which are effective in controlling soil blowing. The natural plant community is mostly tall and mid grasses, grasslike plants, and various sedges. Areas of Els soil are dominated by big bluestem, little bluestem, indiangrass, switchgrass, and prairie cordgrass. Areas of the Ipage soil are dominated by sand bluestem, little bluestem, switchgrass, and prairie sandreed. Areas of the Tryon soil are dominated by switchgrass, indiangrass, big bluestem, and prairie cordgrass. If the plants on Els or Tryon soil are overgrazed or improperly harvested for hay, timothy, redtop, foxtail barley, bluegrass, clover, sedges, and rushes may become dominant. In areas of Ipage soil that are overgrazed or improperly harvested for hay, the soil may be dominated by blue grama, hairy grama, sand dropseed, prairie sandreed, Scribner panicum, and perennial weeds.

The Els and Ipage soils are suited to trees grown in windbreaks. The Tryon soil is not suited to trees in windbreaks because of wetness. Onsite investigation may be needed to select suitable sites for planting windbreaks. Soil blowing and droughtiness are problems on the Ipage soil. Trees need to be planted in a shallow furrow with as little disturbance of the soil as possible. Irrigation can provide supplemental water during droughts. Competition from weeds and undesirable grasses can be controlled by maintaining strips of sod between the rows and in the rows. Areas around the trees can be hoed by hand.

Only the Ipage and Els soils are suited to use as sites for septic tank absorption fields. These soils readily absorb effluent from septic tank absorption fields but do not adequately filter the effluent. Care should be taken that the ground water is not polluted by effluent seeping through the soil. The Tryon soil is not suited to sanitary facilities because of wetness. Sewage lagoons on Ipage and Els soils need to be constructed on fill material to raise the bottom of the lagoon high enough above the seasonal high water table. Sewage lagoons should be lined or sealed to prevent seepage and diked for protection from flooding. The walls or sides of shallow excavations in these soils can be temporarily shored to prevent sloughing or caving. Digging in the Els and Tryon soils should be limited to dry periods for easier operation of machinery and to reduce water problems. If dwellings, with or without basements, and other small buildings are constructed on Tryon and Els soils and if buildings with basements are constructed on the Ipage soil, well-compacted fill material is needed to raise the site above the high water table. Raising the site also provides protection against floodwater on Els and Tryon soils. Constructing roads on suitable, well-compacted fill material and providing adequate side ditches and culverts help to protect roads from damage by flooding and wetness. Road damage caused by frost action can be reduced by providing good surface drainage and by using a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

These soils are assigned to capability unit VIw-5, dryland. The Els soil is in the Subirrigated range site and windbreak suitability group 2S. The Ipage soil is in the Sandy Lowland range site and windbreak suitability group 5. The Tryon soil is in the Wet Subirrigated range site and windbreak suitability group 2D.

Es—Elsmere loamy fine sand, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on bottom lands. It is rarely flooded. Areas range from 25 to several hundred acres in size.

The surface layer is dark grayish brown, very friable loamy fine sand about 12 inches thick. The subsurface layer is also dark grayish brown, very friable loamy fine sand about 7 inches thick. The next layer is grayish brown, very friable sand about 5 inches thick. The underlying material to a depth of more than 60 inches is light brownish gray sand in the upper part, mottled grayish brown loamy sand in the middle part, and mottled light brownish gray sand in the lower part. In a few places, the dark surface layer is less than 10 inches thick. In some places, thin loamy layers are between depths of 20 to 40 inches. In a few places, coarse sand or gravelly coarse sand is below a depth of 20 inches.

Included with this soil in mapping are small areas of Ipage, Loup, Selia, and Tryon soils. Ipage soils are higher on the landscape and are better drained than this soil. The Loup and Tryon soils are lower on the landscape and are poorly drained and very poorly drained. The Selia soils are affected by sodium. Included soils make up 10 to 15 percent of the map unit.

In this Elsmere soil, permeability is rapid. The available water capacity is low. The organic matter content is moderate. Runoff is very slow. The seasonal high water table ranges from a depth of 1.5 feet in wet years to about 2.5 feet in dry years.

Most of the acreage is in native grass and is used for rangeland or native hayland. The rest is used as cropland.

If dryfarmed, this soil is poorly suited to corn and small grains. It is commonly too wet for cultivation during the wettest seasons. During dry parts of the year, the water table subirrigates the soil. This soil is difficult to work early in the spring because of wetness caused by the high water table. Close-growing crops eliminate the need for tilling this soil in spring and protect it from blowing when the surface is dry. The high water table may drown out the alfalfa in some places. Keeping crop residue on the surface helps to control soil blowing.

If this soil is irrigated, it is poorly suited to corn and alfalfa. Sprinkler irrigation is the only suitable method because the soil is too sandy for gravity irrigation. Irrigation water needs to be applied frequently and lightly to prevent waterlogging and deep leaching of nutrients. Wetness may be a problem during wet periods. Soil blowing can be controlled by using conservation tillage, such as stubble-mulch tillage, or by planting winter cover crops and growing close-growing crops. Barnyard manure can be used to increase the organic matter content and improve fertility.

This soil is suited to rangeland and native hay. The natural plant community is mostly tall and mid grasses and grasslike plants dominated by big bluestem, little bluestem, indiangrass, switchgrass, prairie cordgrass, and various sedges. In overgrazed areas or areas improperly harvested for hay, the plant cover may be dominated by timothy, redtop, foxtail barley, clover, sedges, and rushes.

If this soil is used as hayland, mowing needs to be regulated so that the grasses remain vigorous and keep their place in the meadow. In order to allow for carbohydrate storage in the grass plants, mowing should be avoided between boot stage and seed maturity, especially on meadows that are cut each year. The meadow should be mowed before the dominant species reach the boot stage. After frost and during winter, animals usually can graze without damaging the meadows if the proper stocking rate is used.

This soil is suited to trees and shrubs that tolerate occasional wetness. In some years, wetness makes it difficult to establish seedlings and to cultivate between rows. Planting needs to be delayed until the soil begins to dry. The abundant and persistent herbaceous vegetation competes for moisture. The weeds and undesirable grasses can be controlled by cultivation with conventional equipment or by appropriate herbicides.

This soil readily absorbs the effluent from septic tank systems, but it does not adequately filter the effluent. The poor filtering capacity of this soil may result in pollution of the ground water. Sewage lagoons need to be lined or sealed to prevent seepage. Sewage lagoons should be constructed on fill material to raise the bottom of the lagoon high enough above the seasonal high water table. Walls or sides of shallow excavation can be temporarily shored to prevent sloughing or caving. Digging should be limited to dry periods so as to reduce wetness and caving problems. Sites for dwellings and other buildings should be raised with well-compacted fill material because of the high water table and the flood hazard. Constructing roads on suitable, well-compacted fill material and providing adequate side ditches and culverts help protect roads from flood damage and wetness. Road damage caused by frost action can be reduced by providing good surface drainage and by using a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is in capability units IVw-5, dryland, and IVw-11, irrigated, the Subirrigated range site, and windbreak suitability group 2S.

ExB—Elsmere-Selia loamy fine sands, 0 to 3 percent slopes. This complex consists of deep, nearly level and very gently sloping, somewhat poorly drained soils on bottom lands. Areas of this complex range from 30 to 160 acres in size. From 55 to 65 percent of the complex is Elsmere loamy fine sand, and 25 to 35 percent is Selia loamy fine sand. Both soils occupy similar positions and are rarely flooded. Areas of Selia soil are irregular in shape and about 5 to 100 feet across. They are surrounded by the larger areas of

Elsmere soil. The individual areas of the two soils are so intricately mixed or so small that it is not practical to separate them at the scale used in mapping.

Typically, the Elsmere soil has a surface layer of dark grayish brown, very friable loamy fine sand about 10 inches thick. Below this layer is grayish brown, very friable loamy sand about 7 inches thick. The mottled underlying material to a depth of 60 inches or more is light gray and light brownish gray. It is sand in the upper part and loamy sand in the lower part. In some places, the dark surface layer is less than 10 inches thick. In a few areas, loamy material, coarse sand, or gravelly coarse sand is between depths of 20 and 60 inches.

Typically, the Selia soil has a surface layer of gray, very friable loamy fine sand about 3 inches thick. The subsurface layer is calcareous, light gray, very friable fine sand about 1 inch thick. The subsoil is very friable loamy fine sand about 22 inches thick. The upper part of the subsoil is dark grayish brown, and the lower part is light brownish gray. The underlying material to a depth of more than 60 inches is light gray loamy sand in the upper part, light brownish gray loam in the middle part, and light gray loamy sand in the lower part. In some places, the surface layer is fine sandy loam.

Included with these soils in mapping are small areas of Ipage, Loup, and Tryon soils. Loup and Tryon soils are slightly lower on the landscape than the Elsmere and Selia soils and are poorly drained or very poorly drained. Ipage soils are higher on the landscape and are moderately well drained. Included soils make up less than 15 percent of this complex.

Permeability is rapid in the Elsmere soil. In the Selia soil, permeability is slow in the subsoil and rapid in the underlying material. The available water capacity is low, and the organic matter content is moderate in both soils. The water intake rate in the Elsmere soil is very high, and in the Selia soil, it is moderately low. Runoff is slow to very slow, and some is ponded in microdepressions in the areas of Selia soil. The Selia soil contains large amounts of sodium. In both soils, the seasonal high water table ranges from a depth of about 1.5 feet in wet years to about 2.5 feet in dry years. The Elsmere soil is easy to till. The Selia soil is difficult to till because it has a weak structure and becomes very hard when dry.

All the acreage of this map unit is in native grass used for grazing or native hayland. This complex is unsuited to dryfarming because of the high alkalinity of the Selia soil. The alkali condition makes it difficult for crops to take up water; consequently, the Selia soil is quite droughty. Areas of the Elsmere soil are suited to dryfarmed crops, but because they are so intermingled with areas of the Selia soil, they cannot be tilled separately.

If irrigated, these soils are poorly suited to corn and alfalfa. Crops do not grow well on the Selia soil. The principal concerns are reducing alkalinity, maintaining fertility, and controlling soil wetness. Sprinkler irrigation is better suited than other methods of irrigation on these soils because they are too sandy for gravity irrigation. Light, frequent applications of irrigation water are needed to prevent waterlogging and deep leaching of plant nutrients. Soil wetness delays planting in spring and may prevent cultivation. During dry parts of the year, the seasonal high water table can be helpful to grasses and growing crops. Soil fertility needs to be properly balanced because the alkalinity of the Selia soil makes many of the nutrients unavailable to plants. Areas of the Selia soil need applications of barnyard manure and other organic matter in large amounts to help make it more friable and increase the water intake. Soil fertility can also be improved by growing legumes and returning crop residue to the soil. Chemicals are needed to neutralize the alkali in the Selia soil.

Technical assistance is needed before reclamation is begun, and each site needs to be fully investigated. Reclamation of alkali soils is difficult, expensive, and time consuming.

These soils are suited to rangeland and native hay. The alkali problem in the Selia soil is not easy to control. The Selia soil produces mostly short and mid grasses, grasslike plants dominated by alkali sacaton, western wheatgrass, slender wheatgrass, bluegrass, switchgrass, and inland saltgrass. The Elsmere soil produces mostly tall and mid grasses, grasslike plants, and various sedges. Areas of the Elsmere soil are dominated by big bluestem, little bluestem, indiangrass, switchgrass, and prairie cordgrass. In overgrazed areas of Selia soil or in areas improperly harvested for hay, the soil may be dominated by inland saltgrass, foxtail barley, Kentucky bluegrass, sedges, and rushes. In overgrazed areas of Elsmere soil or in areas improperly harvested for hay, timothy, redtop, foxtail barley, ironweed, clover, sedges, and rushes may become dominant. Overgrazing when the surface soil is wet can cause compaction of the surface and small mounds, making it difficult to harvest for hay. The Selia soil generally produces low hay yields. In this complex, areas of the Saline Subirrigated range site (Selia soil) are so intermingled with areas of the Subirrigated range site (Elsmere soil) that it generally is very difficult to manage the sites separately.

The Elsmere soil is suited to planting trees and shrubs in windbreaks, and the Selia soil is unsuited. If the species selected can tolerant occasional wetness from the water table, capacity for growth of adapted species is good on the Elsmere soil. Capacity for growth of adapted species is poor on the Selia soil. Only the trees and shrubs that can tolerate occasional wetness and alkali conditions are suited to this soil. In wet years, planting needs to be delayed until the soil is sufficiently dry. The effects of alkali can be minimized by using salt-tolerant species. The abundant and persistent herbaceous vegetation which grows on the Selia soil is a concern because it competes with the trees. The weeds and grasses between the rows can be controlled by cultivating with conventional equipment or by timely use

of the appropriate herbicides. Areas in the rows and around the trees can be hoed by hand.

These soils readily absorb effluent from the septic tank systems, but they do not adequately filter the effluent. The poor filtering capacity may result in pollution of the ground water. Sewage lagoons need to be constructed on fill material to raise the bottom of the lagoon to a sufficent height above the seasonal high water table. They need to be lined or sealed to prevent seepage. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving. Digging in these soils should be limited to dry periods to reduce water problems and the hazard of caving. Dwellings and other buildings can be constructed on well compacted fill material to overcome wetness caused by the high water table and as protection against flooding.

Constructing roads on suitable, well-compacted fill material and providing adequate side ditches and culverts help protect the roads from flood damage and wetness. Road damage caused by frost action can be reduced by providing good surface drainage and by using a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

These soils are assigned to capability units VIs-1, dryland, and IVs-11, irrigated. The Elsmere soil is in the Subirrigated range site and windbreak suitability group 2S. The Selia soil is in the Saline Subirrigated range site and windbreak suitability group 10.

IgB—Ipage loamy sand, 0 to 3 percent slopes. This deep, nearly level and very gently sloping, moderately well drained soil is mostly on hummocky areas in sandhill valleys and in the Elkhorn River Valley. Areas range from 5 to 200 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy sand about 9 inches thick. The next layer is brown, very friable loamy sand about 4 inches thick. The underlying material is very pale brown to white fine sand to a depth of more than 60 inches. It is mottled below a depth of 22 inches. In some places, the dark surface layer is 10 to 18 inches thick. In a few places, coarse sand or gravelly coarse sand is between depths of 20 to 40 inches.

Included with this soil in mapping are small areas of Els, Elsmere, Libory, Tryon, and Valentine soils. Els, Elsmere, and Tryon soils are on the lower parts of the landscape. Els and Elsmere soils are somewhat poorly drained, and Tryon soils are poorly drained and very poorly drained. Libory soils have a loamy subsoil and a thicker dark surface layer. Valentine soils are higher on the landscape and are excessively drained. Included soils make up 10 to 15 percent of the map unit.

In this Ipage soil, permeability is rapid. The available water capacity is low. The organic matter content is low. The water intake rate is very high. Runoff is slow. The seasonal high water table ranges from a depth of about 3 feet in wet years to about 6 feet in dry years.

Most of the acreage is in rangeland and is used for grazing or native hayland. A small acreage is used as cropland.

If this soil is dryfarmed, it is poorly suited to corn, small grains, and alfalfa. Small grains and the first cutting of alfalfa generally are the better suited crops because they grow and mature in the spring, when there is more rainfall. Soil blowing is a hazard. Establishing crops on this soil is sometimes difficult because soil blowing destroys young seedlings early in the spring. Soil blowing can be reduced, moisture conserved, and the organic matter content and fertility maintained by using a cropping system that keeps the soil surface covered with crops, grass, or crop residue.

If this soil is irrigated, it is suited to corn, small grains, alfalfa, and introduced grasses. Sprinkler irrigation is the only system suitable on this soil. Because the available water capacity is low, frequent, light applications of water are needed to avoid excessive leaching of plant nutrients. Returning crop residue to the soil and using barnyard manure help to increase the organic matter content and improve fertility. Crop residue should be left on the surface to help control soil blowing.

This soil is suited to rangeland, and this use is effective in controlling soil blowing. The natural plant community is mostly tall and mid grasses dominated by sand bluestem, little bluestem, switchgrass, and prairie sandreed. If the plants are overgrazed or improperly harvested for hay, the site may be dominated by blue grama, hairy grama, sand dropseed, prairie sandreed, and numerous annual and perennial weeds.

This soil is suited to planting trees in windbreaks if soil blowing is controlled by maintaining strips of sod or other vegetation between the rows. Drought and competition for moisture from grass and weeds are hazards. Supplemental moisture during dry periods can be provided by irrigation. Weeds and grasses can be controlled by cultivation or by timely use of appropriate herbicides.

This soil generally is suited to use as sites for dwellings without basements. If this soil is used for septic tank absorption fields, care should be taken that the ground water is not polluted by effluent seeping through the soil. This soil readily absorbs effluent from septic tank systems, but it does not adequately filter the effluent. Fill material can be used to raise an absorption field a sufficient height above the seasonal high water table. Sewage lagoons need to be lined or sealed to prevent seepage. They need to be constructed on fill material to raise the bottom of the lagoon to a sufficient height above the seasonal high water table. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving. If buildings with basements are constructed on this Ipage soil, well-compacted fill material is needed to raise the site above

the high water table. Road damage caused by frost action can be reduced by providing good surface drainage and by use of a gravel moisture barrier in the subgrade.

This soil is in capability units IVe-5, dryland, and IVe-11, irrigated, the Sandy Lowland range site, and windbreak suitability group 5.

JsB—Jansen loamy sand, 0 to 3 percent slopes. This soil is moderately deep over coarse sand and gravel. It is nearly level and very gently sloping, well drained, and on uplands. Areas range from 25 to 640 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy sand about 7 inches thick. The subsurface layer is also dark grayish brown, very friable loamy fine sand and is about 4 inches thick. The subsoil is a firm clay loam about 13 inches thick. It is pale brown in the upper part and light yellowish brown in the lower part. The underlying material to a depth of more than 60 inches is very pale brown, coarse sand that is 5 percent gravel by volume. In some places, the surface layer is sandy loam and fine sandy loam.

Included with this soil in mapping are small areas of Boelus, Meadin, Pivot, and Valentine soils. Boelus and Pivot soils are on positions on the landscape similar to those of the Jansen soils. The Boelus soils have loamy underlying material. The Meadin soils generally are lower on the landscape and are less than 20 inches deep to gravelly coarse sand. Pivot soils do not have a loamy subsoil. Valentine soils are higher on the landscape than the Jansen soil and are sandy throughout. Included soils make up 5 to 15 percent of this map unit.

In this Jansen soil, permeability is moderate in the solum and very rapid in the underlying coarse sand. The available water capacity is moderate. The organic matter content is moderately low. The water intake rate is moderate. Runoff is slow. This soil is easily tilled.

Most of the acreage of this soil is used for dryfarmed and irrigated cropland. The rest is in native grass used for range or native hayland.

If this soil is dryfarmed, it is poorly suited to small grains, corn, and alfalfa because the underlying coarse sand makes the soil droughty. Small grains and the first cutting of alfalfa generally are the most dependable crops because they grow and mature in spring when rainfall is the highest. Use of conservation practices, such as stubble-mulch tillage and a cropping system that keeps the soil covered with crops or crop residue most of the year, conserves moisture and reduces the hazard of soil blowing. Additions of barnyard manure improve fertility.

If this soil is irrigated, it is suited to corn, grain or forage, sorghum, and alfalfa. Furrow and border irrigation are effective in areas where land leveling is practical. Deep cuts should be avoided to prevent exposing the coarse underlying material. Sprinkler irrigation systems are suited. Because of the very low moisture retention in the underlying coarse material, crops show the effects of drought if irrigation is not timely. Plant nutrients can be leached from this soil, so application of water should be carefully managed. Returning crop residue to the soil helps to maintain the fertility.

This soil is suited to rangeland use, which is very effective in controlling soil blowing and water erosion. The natural plant community is dominated by sand bluestem, little bluestem, prairie sandreed, and needleandthread. In overgrazed areas or areas that are improperly harvested for hay, the site may be dominated by blue grama, Scribner panicum, sand dropseed, and annual and perennial weeds.

This soil is suited to trees and shrubs planted in windbreaks. Insufficient seasonal rainfall is a limitation when planting trees, and supplemental water may need to be supplied by irrigation. This soil has low available water capacity, and only drought-tolerant trees and shrubs are suitable. Moisture competition from grass and weeds can be controlled by good site preparation and timely cultivation and by use of herbicides.

This soil generally is suited to dwellings with basements. If this soil is used for septic tank absorption fields, care should be taken that the ground water is not polluted by effluent seeping through the soil. This soil readily absorbs effluent from septic tank systems, but it does not adequately filter the effluent. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving. Foundations for buildings without basements need to be strengthened and backfilled with coarse material to prevent damage by the shrinking and swelling of the soil. Roads and streets need to be designed so that the surface pavement and subbase are thick enough to compensate for the low strength of the soil material. Coarse-grained material for subgrade or base material can be used to insure better performance.

This soil is in capability units IVe-6, dryland, and IIIe-7, irrigated, the Sandy range site, and windbreak suitability group 6G.

LcG—Labu-Sansarc silty clays, 11 to 40 percent slopes. This complex consists of well drained, moderately steep to very steep soils on breaks to the Niobrara River Valley. Most areas are dissected by drainageways. The moderately deep Labu silty clay makes up 55 to 70 percent of the unit, and the shallow Sansarc silty clay makes up 25 to 30 percent. The Labu soil is on the long, smooth lower-lying slopes, and the Sansarc soil is on the short, steep slopes of ridgetops and on the shoulders of drainageways. Areas of this complex range from 25 to 200 acres in size. The individual areas of these soils are so intricately mixed or so small that it is not practical to separate them at the scale used in mapping.

Typically, the Labu soil has a surface layer of dark grayish brown, friable silty clay about 6 inches thick. The subsoil is calcareous silty clay about 18 inches thick. It is friable and brown in the upper part and very firm and light yellowish brown in the lower part. The underlying material, about 11 inches thick, is light yellowish brown, calcareous shaly clay. Light yellowish brown, calcareous bedded shale begins at a depth of about 35 inches.

Typically, the Sansarc soil has a surface layer of grayish brown, calcareous, very friable silty clay about 4 inches thick. The underlying material, about 14 inches thick, is light brownish gray, calcareous shaly clay and very shaly clay. Light brownish gray, calcareous bedded shale is at a depth of about 18 inches.

Included with these soils in mapping are small areas of Brunswick, Simeon, Tassel, and Valentine soils. Brunswick soils are moderately deep to weathered sandstone on moderately steep to steep breaks. Simeon and Valentine soils are sandy soils and formed on steep ridges and side slopes. Tassel soils are on steep breaks and are shallow to weathered sandstone. Sandstone and shale crop out on ridgetops and very steep breaks. In some places, the ridgetops are capped with a thin layer of gravel. The inclusions make up 5 to 10 percent of the complex.

Permeability is slow in both Labu and Sansarc soils. The available water capacity is low for the Labu soil and very low for the Sansarc soil. The organic matter content is moderately low in both soils. These soils are fine, plastic clays that hold some of the soil moisture under too much tension to be extracted by plant roots. They shrink and swell markedly on wetting and drying. When the soil is dry, it forms cracks 1 to 3 inches wide. The root zone extends to bedded shale. Runoff is rapid to very rapid.

Most of the acreage of this complex is in native grass and is used as rangeland. The soils in this complex are unsuited to cropland.

These soils are suited to rangeland, and this use is very effective in controlling water erosion. The major problems of range management are the hazard of erosion and droughtiness. The soils are somewhat droughty because of the low available water capacity and water losses by runoff. Management that maintains an adequate plant cover and ground mulch helps to prevent excessive soil losses and increase the moisture supply by reducing runoff. The natural plant community is mostly tall and mid grasses dominated by big bluestem, little bluestem, sideoats grama, green needleandthread, and western wheatgrass. If the plants are overgrazed, big bluestem and little bluestem decrease, and sideoats grama, blue grama, western wheatgrass, and green needleandthread increase. If overgrazing continues for many years, the less desirable plants increase, especially pricklypear, buckbrush, Arkansas rose, western snowberry, and other annual and perennial weeds. Brush management may be needed to control the woody plants.

The Labu soil is poorly suited to trees and shrubs in windbreaks. The Sansarc soil generally is not suited. Because of its high clay content, the soil should be prepared for planting when it is moist but not wet. Growth of trees and shrubs is poor, and species are limited to those which are extremely drought tolerant. Light cultivation and irrigation will close cracks and protect roots. Trees can be planted on the contour to reduce runoff and erosion. Cultivation with conventional equipment and timely use of herbicides will control weeds and undesirable grasses.

These soils generally are not suitable for sanitary facilities and building sites because of the steepness of slopes and slow permeability and because of the shallowness of the Sansarc soil. A suitable alternate site is needed. Roads need to be designed so that the surface pavement and subbase are thick enough to compensate for the low strength of the soil material. Coarse-grained material for subgrade or base material can be used to insure better performance. Cuts and fills generally are needed to provide a suitable grade for roads. The base material for roads and streets can be mixed with additives, such as hydrated lime, to help prevent shrinking and swelling.

These soils are assigned to capability unit VIe-4, dryland, and windbreak suitability group 10. The Labu soil is in the Clayey range site. The Sansarc soil is in the Shallow Clay range site.

LfB—Libory loamy fine sand, 0 to 3 percent slopes. This deep, nearly level and very gently sloping, moderately well drained soil is on uplands. Areas range from 25 to 320 acres in size.

Typically, the surface layer is grayish brown, very friable loamy fine sand about 6 inches thick. The subsurface layer is dark grayish brown, very friable loamy fine sand about 8 inches thick. The next layer is grayish brown fine sand about 10 inches thick. Below this is a subsoil of brown, firm loam about 8 inches thick. The underlying material to a depth of more than 60 inches is a light gray loam that has dark brown mottles. In places, the sandy material is less than 10 inches thick or more than 36 inches thick over the loamy material. In places, this soil has sandy clay loam, clay loam, or sandy loam below a depth of 20 inches, and in a few places coarse sand or gravelly coarse sand is below a depth of 40 inches.

Included with this soil in mapping are small areas of Dunday, Els, Elsmere, and Valentine soils. Dunday soils are in positions on the landscape similar to those of the Libory soils. They are well drained and and do not have loamy underlying material. The Els and Elsmere soils are lower on the landscape and are somewhat poorly drained. Valentine soils are higher on the landscape and

are excessively drained. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the upper part of the Libory soil and moderately slow in the lower part. The available water capacity is moderate. The organic matter content is moderately low. The water intake rate is high. Runoff is slow. In the spring and during wet periods of the year, a water table is perched for a short time above the loamy underlying material. This soil is easily tilled.

A large acreage of this soil is farmed. Some areas are irrigated. The rest is in native grass used for rangeland or hayland.

If this soil is dryfarmed, it is suited to corn, small grains, and alfalfa. Soil blowing is a hazard if the surface is not adequately protected by growing crops or crop residue. Use of conservation tillage practices, such as disking or chiseling, that keep all or part of the crop residue on the soil surface helps to prevent soil blowing and conserves soil moisture. Small grains and first-cutting alfalfa generally are dependable crops because they grow and mature in spring, when rainfall is highest. Adding barnyard manure increases the organic matter content and fertility.

If this soil is irrigated, it is suited to corn, grain or forage, sorghum, alfalfa, and introduced grasses. In periods of above-normal rainfall, wetness caused by the perched water table can be a problem in some places. Soil blowing is a hazard if the surface is not adequately protected by growing crops or crop residue. Conservation tillage practices, such as disking, leave crop residue on the surface to help prevent soil blowing and conserve soil moisture. Light, frequent applications of irrigation water are needed. Excess water leaches fertilizer below the plant roots. Returning crop residue to the soil and using barnyard manure help to increase the organic matter content and improve fertility.

This soil is suited to rangeland, and this use is effective in controlling soil blowing. The natural plant community is mostly tall and mid grasses dominated by sand bluestem, little bluestem, switchgrass, and prairie sandreed. In overgrazed areas or areas improperly harvested for hay, the soil may be dominated by blue grama, hairy grama, sand dropseed, prairie sandreed, Scribner panicum, and numerous annual and perennial weeds.

This soil is suited to growing trees and shrubs in windbreaks. Only trees or shrubs tolerant of slightly sandy, somewhat droughty conditions are suited. Insufficient moisture and severe soil blowing are the main hazards in establishing trees. Soil blowing can be controlled by maintaining strips of sod or other vegetation between the rows. Supplemental water needs to be provided by irrigation during extended dry periods. Undesirable grasses and weeds can be controlled by cultivation or by using appropriate herbicides.

The sandy material in the upper part of this soil has poor filtering capacity for septic tank absorption fields. It readily absorbs effluent from septic tank absorption fields but does not adequately filter the effluent. Care should be taken that the proper fill material is used for the absorption field to function properly and to avoid contamination of the ground water. Sewage lagoons need to be lined or sealed to prevent seepage, and they need to be constructed on fill material to raise the bottom of the lagoon to a sufficient height above the water table. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving. Digging should be limited to dry periods to reduce wetness. Sites for dwellings and other buildings should be raised with well-compacted fill material because of the perched water table.

Constructing roads on suitable, well-compacted fill material and providing adequate side ditches and culverts help protect the roads from wetness.

This soil is assigned to capability units IIIe-6, dryland, and IIIe-10, irrigated, the Sandy Lowland range site, and windbreak suitability group 5.

Lo—Loup fine sandy loam, 0 to 2 percent slopes. This deep, nearly level, poorly drained soil is on bottom lands of the Elkhorn River Valley and around marshes and lakes in the sandhills. This soil is rarely flooded. Areas range from 15 to more than 500 acres in size.

Typically, the surface layer is very dark gray, calcareous, very friable fine sandy loam about 7 inches thick. The subsurface layer is dark gray, friable fine sandy loam about 3 inches thick. The next layer is gray, friable loamy sand, about 4 inches thick, that has grayish brown mottles. The underlying material to a depth of more than 60 inches is light gray, mottled fine sand and loamy sand. In places, the dark surface layer is less than 7 inches thick or more than 20 inches thick. In some areas near the sandhills, a thin layer of light colored fine sand is on the surface. In a few places, the underlying material is finely stratified with loamy material. Water may be ponded in low areas and drainageways for a few days in the spring and during wet periods.

Included with this soil in mapping are small areas of Els, Elsmere, Ipage, and Marlake soils. Els and Elsmere soils are higher on the landscape and are somewhat poorly drained. Ipage soils are moderately well drained and are higher on the landscape. Marlake soils are on lower positions and have a higher seasonal water table than this Loup soil. Alkali-affected soils are common along the outer edge of areas of this soil. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in this Loup soil. The available water capacity is low. The organic matter content is high. Runoff is slow. The seasonal high water table is at the surface in wet years and drops to about 1.5 feet below the surface in dry years. It normally recedes to a depth of 2 to 3 feet by late summer.

This soil is in native grass and is used for rangeland or native hayland (fig. 8). It normally is too wet for cropland.

Figure 8.—An area of Loup fine sandy loam, 0 to 2 percent slopes, in a Wet Subirrigated range site. Old cottonwood tree claims cover part of this wet hay meadow.

This soil is suited to rangeland and native hay. The natural plant community is mostly tall and mid grasses and grasslike plants dominated by switchgrass, indiangrass, big bluestem, prairie cordgrass, and various sedges. If the plants are overgrazed or improperly harvested for hay, the site may be dominated by timothy, redtop, foxtail barley, clover, sedges, and rushes. When the surface soil is wet, overgrazing can cause surface compaction and small mounds, making it difficult to harvest for hay.

If this soil is used for native hayland, mowing needs to be regulated so that the grasses remain vigorous. In order to allow for carbohydrate storage in the plants in meadows, mowing should be avoided between boot stage and seed maturity. Large areas can be divided into three parts and mowed in rotation. One-third should be mowed two weeks before the plants reach the boot stage, one-third at boot stage, and one-third in the early flowering period. The areas should be rotated in successive years. If a rancher has plenty of hay, the entire area may be left idle 1 year in 3, particularly if the rotation mowing plan is not followed. After frost and during winter, range animals usually can graze without damaging meadows if the areas are properly stocked. Range animals must be removed before frost moves out of the soil and the water table reaches a high level.

This soil is poorly suited to trees and shrubs planted in windbreaks. Only the trees and shrubs tolerant of a very high water table are suited to this soil. Establishment of trees can be a problem in wet years and may require special methods of planting so that seedlings do not drown. Planting should be delayed until the water table recedes and the soil is dry enough for tillage. The weeds and undesirable grasses can be controlled by cultivation when the water table is lowest.

This soil is not suitable for sanitary facilities and dwellings because of wetness. A suitable alternate site is needed. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving if the shoring is done during the dry season. Constructing roads on suitable, well-compacted fill material and providing adequate side ditches and culverts help to protect roads from wetness.

This soil is in capability unit Vw-7, dryland, the Wet Subirrigated range site, and windbreak suitability group 2D.

Lp—Loup fine sandy loam, wet, 0 to 2 percent slopes. This deep, nearly level, very poorly drained soil is on bottom lands along the Elkhorn River Valley and around marshes and lakes in the sandhills. This soil is rarely flooded but is occasionally ponded by water from a very high water table. Areas range from 5 to 160 acres in size.

Typically, the surface layer is dark gray, very friable fine sandy loam about 10 inches thick. The subsurface

layer is very dark gray, very friable fine sandy loam about 9 inches thick. Below this layer is light gray loamy fine sand, about 6 inches thick, that has yellowish brown mottles. The underlying material to a depth of 50 inches is mottled light gray fine sand. At a depth of 50 inches, the sandy underlying material is interrupted by a layer of dark gray sandy loam that extends to a depth greater than 60 inches. A thin layer of light colored fine sand is on the surface in some areas near the sandhills. Coarse sand is below a depth of 20 inches in some places. In some places, the dark surface layer is less than 7 inches thick.

Included with this soil in mapping are small areas of Els, Elsmere, and Marlake soils. Els and Elsmere soils are on higher landscape positions and are somewhat poorly drained. Marlake soils are lower on the landscape and have a higher seasonal water table. Alkali-affected soils are common along the outer edge of areas of this soil. Included soils make up 5 to 15 percent of the map unit.

In this Loup soil, permeability is rapid. The available water capacity is low. The organic matter content is high. Runoff is slow. The seasonal high water table ranges from about 0.5 foot above the surface in wet years to about 1.0 foot below the surface in dry years. This soil may be ponded for a week or more at a time in wet periods. The water table normally recedes to a depth of 1 to 2 feet by late summer.

This soil is in native grass used for rangeland or native hayland. It is not suited to crops because it is too wet.

This soil is suited to rangeland or native hay. The natural plant community is mostly tall and mid grasses and grasslike plants dominated by prairie cordgrass, bluejoint reedgrass, northern reedgrass, and various sedges. If the plants are overgrazed or improperly harvested for hay, the site may be dominated by timothy, redtop, foxtail barley, red clover, sedges, and rushes. If the site is grazed early in spring, small mounds will develop, making it difficult to harvest for hay.

If this soil is used for native hayland, mowing needs to be regulated so that the grasses remain vigorous. Some hay meadows can be improved by installing V-shaped ditches to hasten surface drainage and by seeding reed canarygrass into the existing grasses. In some years forage cannot be harvested because of wetness. A proper mowing sequence should be followed. The meadow should be cut before the dominant grasses reach the boot stage. Mowing should be avoided between boot stage and seed maturity. After frost and during winter, animals can graze without damaging the meadows if the areas are properly stocked. Range animals should be removed before frost leaves the soil and the water table reaches a high level.

This soil is unsuitable for trees and shrubs planted in windbreaks because of wetness. Some areas can be used for recreational, wildlife, or forestation plantings of tolerant trees and shrubs if they are hand planted or other special practices are used.

This soil is not suited to sanitary facilities and dwellings because of wetness and ponding. A suitable alternate site is needed. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving if the shoring is done during the dry season. Constructing roads on suitable, well-compacted fill material above the ponding level and providing adequate side ditches and culverts help protect the roads from damage by ponding and wetness.

This soil is in capability unit Vw-7, dryland, the Wetland range site, and windbreak suitability group 10.

Ma—Marlake loamy fine sand, 0 to 1 percent slopes. This soil is deep, nearly level, and very poorly drained. It is mostly in depressions or basins on valley floors and in low areas bordering lakes and streams. It is frequently ponded by water from a very high water table. Areas range from 15 to 100 acres in size.

Typically, the surface layer is dark gray, very friable loamy fine sand about 8 inches thick. The underlying material is light brownish gray, stratified fine sand about 4 inches thick. Between depths of 12 and 19 inches is a buried layer of dark grayish brown, mottled loamy sand. Below this, to a depth of more than 60 inches, is white, mottled sand.

Included with this soil in mapping are small areas of Els, Elsmere, Loup, and Tryon soils. Els and Elsmere soils are somewhat poorly drained and occur slightly higher on the landscape. Loup soils have a darker, loamy surface layer than this soil. Tryon and Loup soils are poorly drained and occur slightly higher on the landscape. In some places, the outer edge of areas of this soil is severely affected with alkali. Included soils make up 5 to 10 percent of the unit.

In this Marlake soil, permeability is rapid. The available water capacity is low. The organic matter content is high. The seasonal high water table fluctuates from as much as 2.0 feet above the surface in wet years to about 1.0 foot below the surface in dry years. This soil is ponded for long periods during most years. During extended dry periods, the water table will normally recede below the surface.

This soil is used mostly as wildlife habitat. In the driest years, some areas in meadows are mowed for mulching material.

Areas of this soil are too wet for use as cultivated cropland, hayland, or range. The vegetation is coarse and nonpalatable for livestock. The vegetation consists mainly of cattails, rushes, arrowheads, willows, and other water-tolerant plants. In some places, V-shaped ditches can be installed to hasten and improve surface drainage. Grasses such as prairie cordgrass and reed canarygrass may then be established in the areas. Excessive wetness prevents mowing across these areas, except in extremely dry years.

Because of wetness, this soil is unsuited to trees and shrubs planted in windbreaks. A few marginal areas can be used for recreation, wildlife, and forest plantings of tolerant trees or shrubs if they are hand planted or other special approved practices are used.

This soil generally is not suited to use as septic tank absorption fields, sewage lagoons, and building sites because of ponding caused by the seasonal high water table. A suitable alternate site is needed. Constructing roads on suitable, well-compacted fill material above the ponding level and providing adequate side ditches and culverts help protect the roads from damage by ponding.

This soil is assigned to capability unit VIIIw-7 and windbreak suitability group 10. No range site is assigned.

MeB—Meadin sandy loam, 0 to 3 percent slopes. This soil is nearly level and very gently sloping and excessively drained. It is on uplands. It is shallow over coarse sand and gravelly coarse sand. Areas range from 25 to 320 acres in size.

Typically, the surface layer is dark grayish brown, very friable sandy loam about 4 inches thick. The next layer, which is about 4 inches thick, is brown, very friable sandy loam. The underlying material to a depth of more than 60 inches is light yellowish brown coarse sand in the upper part and pale brown gravelly coarse sand in the lower part. In some places, a clayey layer 3 to 6 inches thick is above the gravelly coarse sand. The gravelly coarse sand is at the surface in a few places.

Included with this soil in mapping are small areas of Jansen, O'Neill, Pivot, Simeon, and Valentine soils. Jansen, O'Neill, and Pivot soils are in positions on the landscape similar to those of the Meadin soils. These soils are moderately deep over the coarse sand or gravelly coarse sand. Simeon soils are on slightly higher positions on the landscape and contain less gravel. Valentine soils are also on higher landscapes and are deep, sandy soils. Included soils make up 10 to 15 percent of the unit.

In this Meadin soil, permeability is rapid in the upper part and very rapid in the lower part. The available water capacity is low. The organic matter content is moderately low. The water intake rate is high. Runoff is very slow.

Most of the acreage of this soil is in native grass and is used for rangeland. This soil is too droughty for dryfarming. Very few areas are irrigated.

In irrigated areas, this soil is poorly suited to corn and alfalfa. Small grains are better suited. This soil is best suited to sprinkler irrigation. Because of the high water-intake rate and rapid permeability of the soil, leaching of nutrients below the root zone is a problem if this soil is overirrigated. Water needs to be applied lightly and frequently to avoid leaching. Low available water capacity makes timely irrigation critical in management. Slight delays in irrigation water applications can result in partial to complete crop losses on this soil. Use of conservation tillage practices, such as disking and stubble-mulch tillage, keeps crop residue at the surface for controlling soil blowing and conserving the available moisture. Returning crop residue to the soil and using barnyard manure help maintain fertility and increase the organic matter content.

This soil is suited to rangeland, and this use is effective in controlling soil blowing. The natural plant community is mostly tall and mid grasses dominated by sand bluestem, little bluestem, prairie sandreed, needleandthread, blue grama, and sand dropseed. If the plants are overgrazed, sand bluestem, little bluestem, and prairie sandreed decrease, and blue grama, sand dropseed, and needleandthread increase. Under continuous overgrazing, the less desirable plants increase, including sand dropseed, sand paspalum, hairy grama, plains pricklypear, and clubmoss.

This soil is unsuited to trees and shrubs planted in windbreaks because of the shallow root zone and low available water capacity. Some areas can be used for recreational, wildlife, and forest plantings of tolerant trees and shrubs if they are hand planted or other special approved practices are used.

This soil generally is suited to use for dwellings and local roads and streets. If it is used for septic tank absorption fields, care should be taken that pollution by seepage does not contaminate nearby water supplies. This soil readily absorbs effluent from septic tank systems, but it does not adequately filter the effluent. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving.

This soil is assigned to capability units VIs-4, dryland, and IVs-14, irrigated, the Shallow to Gravel range site, and windbreak suitability group 10.

Oe—O'Neill sandy loam, 0 to 2 percent slopes. This nearly level, well drained soil is on uplands. It is moderately deep over sand. Areas range from 25 to 300 acres in size.

Typically, the surface layer is dark gray, very friable sandy loam about 4 inches thick. The subsurface layer is dark grayish brown, very friable sandy loam about 12 inches thick. The subsoil is grayish brown, very friable sandy loam about 12 inches thick. The underlying material to a depth of 60 inches is pale brown and very pale brown sand that is about 10 percent gravel. In a few places, the soil is dark to a depth of more than 20 inches. In places, the underlying material is loamy fine sand or fine sand.

Included with this soil in mapping are small areas of Meadin, Pivot, Simeon, and Valentine soils. Meadin soils are lower on the landscape and have gravelly coarse sand between depths of 8 and 20 inches. Pivot soils have a sandier texture. The excessively drained Simeon and Valentine soils are higher on the landscape. Included soils make up 10 to 15 percent of the map unit.

In this O'Neill soil, permeability is moderately rapid in the subsoil and very rapid in the underlying material. The available water capacity is low. The organic matter content is moderately low. The water intake rate is moderately high. Runoff is slow.

Most of the acreage of this soil is cropland. The remaining acreage is in native grass used for rangeland. About half the acreage of cropland is irrigated.

If dryfarmed, this soil is suited to corn, grain or forage sorghum, small grains, and alfalfa. Soil blowing is the main hazard in areas where the surface is not well protected by growing crops or crop residue. Conservation tillage practices, such as disking and chiseling, can be used to keep all or part of the crop residue on the surface of the soil to help prevent soil blowing and conserve soil moisture. This soil is droughty because of its low available water capacity. Adding barnyard manure and returning available crop residue to the soil help maintain the organic matter content and soil fertility.

If this soil is irrigated, it is suited to corn, grain or forage sorghum, alfalfa, and introduced grasses. The sprinkler and gravity irrigation systems are suitable for this soil. For gravity irrigation systems, some land grading generally is needed. Where deep cuts are made into the gravelly coarse sand underlying material, backfilling with finer textured material may be needed. Light, frequent applications of irrigation water are needed. Soil blowing is a serious hazard. Soil blowing can be reduced and soil moisture conserved by the use of stubble-mulch tillage and of cropping systems that keep the soil covered with crops or crop residue most of the time. Adding barnyard manure to the soil increases the organic matter content and improves natural fertility and the water intake rate.

This soil is suited to rangeland, and this use is very effective in controlling soil blowing. The natural plant community is dominated by sand bluestem, little bluestem, prairie sandreed, switchgrass, and needleandthread. In overgrazed areas, the soil may be dominated by blue grama, Scribner panicum, sand dropseed, and numerous annual and perennial weeds.

This soil is suited to trees and shrubs planted in windbreaks. If trees are planted, insufficient seasonal rainfall is a limitation, and supplemental water may need to be supplied by irrigation. This soil has low available water capacity, and only those trees and shrubs which tolerate droughts are suitable. Moisture competition from grass and weeds can be controlled by good site preparation and timely cultivation and use of herbicides.

This soil generally is suited to use as dwellings. This soil readily absorbs the effluent from septic tank systems, but it does not adequately filter the effluent. The poor filtering capacity may result in pollution of nearby water supplies. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving. Damage to roads and streets by frost action can be reduced by providing good surface drainage. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is assigned to capability units IIIe-3, dryland, and IIIe-9, irrigated, the Sandy range site, and windbreak suitability group 6G.

OeC—O'Neill sandy loam, 2 to 6 percent slopes. This gently sloping, well drained soil is on side slopes along drainageways. It is moderately deep over sand and gravelly sand. Areas range from 25 to 200 acres in size.

Typically, the surface layer is dark grayish brown, very friable sandy loam about 7 inches thick. The subsurface layer is dark grayish brown, very friable fine sandy loam about 10 inches thick. The subsoil is about 15 inches thick. It is brown, very friable sandy loam in the upper part and pale brown, very friable sandy loam with gravel in the lower part. The underlying material to a depth of more than 60 inches is very pale brown. It is sand in the upper part and gravelly sand in the lower part. In places, the surface layer is loam or loamy sand. In places, the underlying material is fine sand. In a few places, the dark surface layer is more than 20 inches thick.

Included with this soil in mapping are small areas of the Brunswick, Ord, Pivot, Simeon, and Valentine soils. The Brunswick soils have sandstone in the underlying material and generally are higher on the landscape than the O'Neill soil. Ord soils are somewhat poorly drained and are lower on the landscape. Pivot soils contain more sand in the surface layer. The Simeon and Valentine soils are excessively drained and are higher on the landscape. Included soils make up 10 to 15 percent of this unit.

In this O'Neill soil, permeability is moderately rapid in the subsoil and very rapid in the underlying material. The available water capacity is low. Organic matter content is moderately low. The water intake rate is moderately high. Runoff is slow to medium.

About half the acreage is used as cropland under dryland and irrigated farming. The rest of this unit is in native grass used for grazing.

If dryfarmed, this soil is poorly suited to corn, grain and forage sorghum, small grains, and alfalfa. Soil blowing and water erosion are hazards. Erosion by wind and water can be reduced and moisture conserved if stubble-mulch tillage practices are used and the soil is kept covered with crops or crop residue most of the time. Contour farming helps to prevent water erosion. Adding barnyard manure to the soil improves fertility. Wind stripcropping reduces soil blowing.

If this soil is irrigated, it is suited to corn, grain and forage sorghum, alfalfa, and introduced grasses. This soil is best suited to sprinkler irrigation. Frequent, light applications of irrigation water are needed. Contour farming and stripcropping along with stubble-mulch

tillage reduce water erosion. Disking and other tillage practices that keep the crop residue at the surface help to control erosion, conserve moisture, and increase the water intake rate. Adding barnyard manure to the soil helps to maintain fertility and increase the organic matter content.

This soil is suited to rangeland, and this use is very effective in controlling soil blowing and water erosion. The natural plant community is dominated by sand bluestem, little bluestem, prairie sandreed, switchgrass, and needleandthread. Overgrazed areas of the soil may be dominated by Scribner panicum, blue grama, sand dropseed, and numerous annual and perennial weeds.

This soil is suited to trees and shrubs grown in windbreaks. The low available water capacity makes this soil droughty, and only those trees and shrubs which are tolerant of droughtiness are suited unless supplemental water is supplied by irrigation. Competition from grasses and weeds can be controlled by cultivation; areas near the trees can be rototilled or hoed by hand. Soil blowing can be controlled by maintaining strips of sod between the rows.

This soil generally is suited to use as dwellings. It readily absorbs the effluent from septic tank systems, but it does not adequately filter the effluent. The poor filtering capacity may result in pollution of nearby water supplies. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving. Road damage caused by frost action can be reduced by providing good surface drainage. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is in capability units IVe-3, dryland, and IVe-9, irrigated, the Sandy range site, and windbreak suitability group 6G.

OhD—O'Neill-Meadin sandy loams, 6 to 11 percent slopes. This complex consists of strongly sloping soils on side slopes along drainageways. The O'Neill soil is well drained and moderately deep over coarse sand. The Meadin soil is excessively drained and shallow over coarse sand. About 50 to 65 percent of this complex is O'Neill sandy loam, and 20 to 35 percent is Meadin sandy loam. The O'Neill soil occurs on the concave mid and lower side slopes. The Meadin soil occurs mostly on the convex upper side slopes or shoulders and on narrow ridgetops. The individual areas of these soils are so intricately mixed or so small that it is not practical to separate them at the scale used in mapping. Areas of this complex range from 20 to 300 acres in size.

Typically, the O'Neill soil has a dark gray, very friable sandy loam surface layer about 8 inches thick. The subsurface layer is dark grayish brown, very friable sandy loam about 6 inches thick. The subsoil is about 12 inches thick. It is dark brown, very friable sandy loam in the upper part and brown, very friable sandy loam with 7 percent gravel in the lower part. The underlying material is pale brown coarse sand that is 7 percent gravel to a depth of more than 60 inches. In a few places, the surface layer is less than 7 inches thick.

Typically, the Meadin soil has a very dark gray, very friable sandy loam surface layer about 9 inches thick. The subsurface layer is dark grayish brown, very friable sandy loam about 7 inches thick. The next layer is grayish brown, very friable loamy sand about 3 inches thick. The underlying material to a depth of 60 inches is pale brown gravelly coarse sand in the upper part and coarse sand in the lower part. In a few areas, the gravelly coarse sand is at a depth of less than 8 inches.

Included with this complex in mapping are small areas of Brunswick, Pivot, Simeon, Tassel, and Valentine soils. Brunswick and Tassel soils have weathered sandstone in the underlying material. Pivot soils contain more sand in the subsoil. Simeon and Valentine soils are sandier throughout and are higher on the landscape. Included soils make up 10 to 15 percent of the map unit.

Permeability in the O'Neill soil is moderately rapid in the subsoil and very rapid in the underlying material. In the Meadin soil, permeability is rapid in the upper part and very rapid in the lower part. The available water capacity is low in both soils. Both soils have moderately low organic matter content. Runoff is medium.

About half the acreage is in native grass and is used for grazing. The rest is used for cropland under dryland and irrigation management.

These soils are unsuitable for dryfarming because they are too shallow and droughty and are subject to water erosion.

If these soils are irrigated, they are poorly suited to alfalfa and introduced grasses. Row crops are not well suited because the slope is steep. Gravity irrigation is not suitable because of sandiness and steepness of slope. Wheel-track erosion can be a problem under sprinkler irrigation by center pivots. Soil blowing and water erosion are hazards if the surface is not protected. Contour farming and a cropping system that keeps the soil covered with crops, grass, or crop residue most of the time need to be used to control runoff and erosion. Returning crop residue to the soil and using barnyard manure increase the organic matter content and improve fertility.

These soils are suited to rangeland, and this use is effective in controlling soil blowing and water erosion. The natural plant community is dominated by sand bluestem, little bluestem, switchgrass, prairie sandreed, needleandthread, blue grama, and sand dropseed. In overgrazed areas of O'Neill soil, the site may be dominated by Scribner panicum, blue grama, sand dropseed, and numerous annual and perennial weeds. In overgrazed areas of Meadin soil, the range may be dominated by blue grama, sand dropseed, and needleandthread. If overgrazing continues for many

years, the less desirable plants increase, including sand paspalum, hairy grama, plains pricklypear, and clubmoss.

The O'Neill soil is suited to trees and shrubs planted in windbreaks. The Meadin soil is unsuited to windbreak plantings because of a shallow root zone and low available water capacity. Before planning a windbreak, onsite investigations are needed. Insufficient rainfall is the main hazard to seedling establishment. Drought-tolerant species should be planted. Moisture competition from weeds and grasses can be controlled by cultivation between the rows with conventional equipment. Careful use of herbicides or hoeing by hand can control weeds in the row. Use of herbicides may cause problems due to leaching. Irrigation can provide supplemental moisture during periods of insufficient rainfall.

If these soils are used for septic tank absorption fields, care should be taken that pollution by seepage does not contaminate nearby water supplies. These soils readily absorb effluent from septic tank systems but do not adequately filter the effluent. Sewage lagoons need to be lined or sealed to prevent seepage. Grading is required to modify the slope and shape the lagoon. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving. Dwellings should be properly designed to complement the slope, or the site can be graded. Cuts and fills generally are needed to provide a suitable grade for roads and streets. In areas of the O'Neill soil, damage to roads and streets by frost action can be reduced by providing good surface drainage. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage.

These soils are assigned to capability units VIe-3, dryland, and IVe-9, irrigated. The O'Neill soil is in the Sandy range site and windbreak suitability group 6G. The Meadin soil is in the Shallow to Gravel range site and windbreak suitability group 10.

Or—Ord loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on bottom lands. Areas are rarely flooded. Areas range from 25 to 160 acres or more in size.

Typically, the surface layer is very dark grayish brown, calcareous, very friable loam about 7 inches thick. The subsurface layer is calcareous, very friable loam about 11 inches thick. It is dark gray in the upper part and gray in the lower part. Below this layer is grayish brown, calcareous, very friable sandy loam about 3 inches thick. The underlying material is light brownish gray sand to a depth of more than 60 inches. At a depth of 27 inches, the underlying material is interrupted by an 11-inch buried layer of dark grayish brown loamy sand. The lower part of the underlying material is mottled. In some places, the surface layer is noncalcareous.

Included with this soil in mapping are small areas of Meadin, O'Neill, Pivot, and Vetal soils, which are higher on the landscape and are better drained than this soil. Meadin soils are shallow to sand and gravel. O'Neill soils are well drained. Pivot soils have a sandy surface layer. Both soils are underlain by sand and gravel between depths of 20 and 36 inches. Vetal soils have a dark surface layer more than 20 inches thick. Included soils make up 10 to 15 percent of the unit.

In the upper part of this Ord soil, permeability is moderately rapid, and in the lower part it is rapid. The available water capacity is moderate. The organic matter content is moderate. Runoff is slow. The water intake rate is moderately high. The seasonal high water table ranges from a depth of 1.5 feet in wet years to 3.5 feet in dry years.

About two-thirds of the acreage of this soil is used as cropland. The remaining acreage is in native grass and is used for range or hayland.

If this soil is dryfarmed, it is suited to corn, grain or forage sorghum, alfalfa, small grains, and introduced grasses. Spring-sown small grains are not so well suited because the water table usually is highest in the spring, and wetness delays seedbed preparation. The water table may drown out alfalfa in some low spots, but growing alfalfa and winter wheat eliminates the need for tillage in the spring when the soil is wet. Returning crop residue to the soil helps to maintain the organic matter content.

If this soil is irrigated, it is suited to corn, sorghum, alfalfa, and introduced grasses. Land leveling generally is needed if the furrow and border methods of irrigation are used. Sprinkler irrigation is well suited. This soil is slow to dry out in the spring, and tillage operations may be delayed due to wetness. Tiling is normally not required for irrigation, but the water table can be a problem in wet periods. If suitable outlets are available, drainage ditches or tile drains can be used to lower the water table. Crop residue left on the surface in winter protects this soil from blowing.

This soil is suited to rangeland and native hay. The natural plant community is mostly tall and mid grasses and grasslike plants dominated by big bluestem, little bluestem, indiangrass, switchgrass, prairie cordgrass, and various sedges. In overgrazed areas or areas improperly harvested for hay, the soil may be dominated by timothy, redtop, foxtail barley, ironweed, clover, sedges, and rushes.

This soil is suited to trees planted in windbreaks. Only the trees and shrubs tolerant of a moderately high water table are suited. Establishment of seedlings can be a problem during wet years. The soil should be tilled and seedlings planted only after the soil dries out. The abundant and persistant herbaceous vegetation on this soil is a concern because it competes with the trees. Weeds and grasses can be controlled by cultivating between the rows with conventional tillage equipment and by timely use of herbicides. Areas near trees can be rototilled or hoed by hand.

Care should be taken that pollution by seepage from septic tank absorption fields does not contaminate the ground water. If sewage lagoons are constructed on this soil, fill material should be used to raise the bottom of the lagoon high enough above the seasonal high water table. Sewage lagoons should be lined or sealed to prevent seepage. Digging should be limited to dry periods for easier operation of machinery and to avoid cave-in and water problems. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing and caving. Sites for dwellings and other buildings should be raised with well-compacted fill material because of the high water table and flood hazard. Road damage caused by frost action can be reduced by providing good surface drainage and using a gravel moisture barrier in the subgrade. Crowning the road by grading will provide needed surface drainage.

This soil is in capability units IIw-4, dryland, and IIw-8, irrigated, the Subirrigated range site, and windbreak suitability group 2S.

PtB—Pivot loamy sand, 0 to 3 percent slopes. This nearly level and very gently sloping, somewhat excessively drained soil is on uplands. Areas range from 20 to 500 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy sand about 6 inches thick. The subsurface layer is grayish brown, very friable loamy sand about 7 inches thick. The next layer is brown, very friable sand about 14 inches thick. The underlying material to a depth of more than 60 inches is very pale brown coarse sand containing some gravel. In some places, the surface layer is sandy loam and fine sandy loam. In some areas, the dark surface layer is less than 10 inches thick. In some places, a thin layer of loamy material is above the coarse sand. In places, the underlying material is fine sand or sand.

Included with this soil in mapping are small areas of Boelus, Meadin, O'Neill, Ord, and Valentine soils. Boelus soils are on slightly higher positions on the landscape and have loamy underlying material. Meadin soils are shallow to gravelly coarse sand. O'Neill soils are finer textured above the coarse sand, sand, or gravelly coarse sand. Meadin and O'Neill soils are in positions on the landscape similar to those of the Pivot soils. Ord soils are lower on the landscape and are somewhat poorly drained. Valentine soils are on higher, hummocky positions and are excessively drained. Included soils make up 10 to 15 percent of the map unit.

In this Pivot soil, permeability is rapid in the upper part and very rapid in the coarse sand. The available water capacity is low. The organic matter content is moderately low. Runoff is very slow because the water intake rate is very high.

About half the acreage of this soil is used for irrigated cropland. The rest is in native grass. The native grass areas are used mostly for grazing, but a small acreage is harvested for hay.

If this soil is dryfarmed, it is poorly suited to corn, sorghum, alfalfa, and small grains. Soil blowing is a hazard if the surface is not adequately protected by growing crops or crop residue. Conserving soil moisture is a problem. Soil blowing can be reduced, moisture conserved, and the organic matter content and fertility maintained by using a cropping system that keeps the soil covered with crops, crop residue, or grass. The use of row crops in the cropping sequence should be limited and maximum use made of close-growing crops to protect the soil. The low available water capacity makes this soil quite droughty.

If this soil is irrigated, it is suited to corn, sorghum, alfalfa, small grains, and introduced grasses. Sprinkler irrigation is better suited to this soil. Frequent, light applications of water are needed because of the low available water capacity and to avoid excessive leaching. This soil is too sandy for gravity irrigation. Soil blowing is a hazard. Tillage practices that keep crops or crop residue on the surface help to control soil blowing and conserve moisture. Crop residue should be left on the soil in winter to reduce soil blowing. Returning crop residue to the soil and using barnyard manure help to increase the organic matter content and fertility.

This soil is suited to rangeland, and this use is very effective in controlling soil blowing and water erosion. The natural plant community is dominated by sand bluestem, little bluestem, prairie sandreed, switchgrass, and needleandthread. If the plants are overgrazed, the site may be dominated by Scribner panicum, blue grama, sand dropseed, and numerous annual and perennial weeds.

A few areas in native grass are mowed for hay. The grass should be mowed only about once in 2 years. If the grass is mowed one summer, it should not be grazed the next summer. If the proper stocking rate is used, the grass can be safely grazed in fall or winter.

This soil is suited to trees and shrubs planted in windbreaks if soil blowing is controlled by maintaining strips of sod or other vegetation between the rows. Drought and competition for moisture from grass and weeds are hazards. Trees and shrubs need to be watered during droughts. Weeds and undesirable grasses in the tree rows can be controlled by cultivation and by timely use of herbicides. Areas near the trees can be rototilled or hoed by hand.

This soil generally is suited to building sites and sites for local roads and streets. If this soil is used for septic tank absorption fields, care should be taken that effluent does not seep through the soil and contaminate nearby water supplies. The soil readily absorbs effluent from septic tank systems but does not adequately filter the effluent. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of shallow

excavations can be temporarily shored to prevent sloughing or caving.

This soil is in capability units IVe-5, dryland, and IIIe-14, irrigated, the Sandy range site, and windbreak suitability group 5.

PvD—Pivot-Valentine complex, 0 to 9 percent slopes. This complex consists of deep, nearly level to strongly sloping soils on uplands. The Pivot soils are somewhat excessively drained, and the Valentine soils are excessively drained. The Pivot soils make up about 55 to 65 percent of this complex, and Valentine soils make up 25 to 35 percent. The Pivot soils are nearly level to gently sloping, and the Valentine soils are hummocky. The individual areas of these soils are so intricately mixed that it is not practical to separate them at the scale used in mapping. Areas of this map unit range from 20 to 300 acres in size.

Typically, the Pivot soils have a surface layer of dark gray, very friable loamy sand about 7 inches thick. The subsurface layer is dark grayish brown, very friable loamy sand about 4 inches thick. The next layer is grayish brown, very friable sand about 5 inches thick. The underlying material to a depth of more than 60 inches is brown sand in the upper part. In the lower part it is pale brown and light yellowish brown coarse sand that contains some gravel.

Typically, the Valentine soils have a surface layer of dark grayish brown, loose fine sand about 9 inches thick. The next layer is brown, loose fine sand about 6 inches thick. The underlying material is pale brown fine sand to a depth of more than 60 inches.

Included with these soils in mapping are small areas of the Boelus, Jansen, Meadin, and O'Neill soils. Boelus, Jansen, and O'Neill soils are in positions on the landscape similar to those of the major soils. The Boelus soils have loamy underlying material and are well drained. Jansen and O'Neill soils have a finer textured subsoil and are well drained. The Meadin soils are shallow to gravelly coarse sand. Included soils make up less than 15 percent of the map unit.

In the Pivot soils, permeability is rapid in the upper part and very rapid in the coarse sand. Permeability in the Valentine soils is rapid. The available water capacity is low in both soils. Organic matter content is moderately low for the Pivot soils and low for the Valentine soils. The water intake rate is very high, and runoff is slow for both soils.

Most of the acreage of this complex is in native grass and is used for grazing. Some areas are used for irrigated cropland.

The soils in this complex are unsuitable for dryfarmed cropland. If these soils are dryfarmed, soil blowing is a moderate to severe hazard. Row crops, such as corn, are generally limited by low fertility and the droughty underlying material. The soils generally are better suited to close-growing crops, such as alfalfa and grasses. These crops grow and mature in the spring when rainfall is more plentiful, and they require less rainfall during their growing season. A conservation cropping system that leaves crop residue on the soil surface gives protection from soil blowing and returns organic matter to the soil.

If irrigated, the soils are poorly suited to alfalfa and corn production. Irrigation is restricted to the sprinkler irrigation method. Automatic sprinkler irrigation systems are particularly well suited. In irrigated areas, cropping systems must include practices that leave crop residue on the soil surface at all times.

These soils are suited to rangeland, and this use is very effective in controlling soil blowing and water erosion. The natural plant community is dominated by sand bluestem, little bluestem, prairie sandreed, sand lovegrass, switchgrass, and needleandthread. In overgrazed areas, the site may be dominated by needleandthread, prairie sandreed, blue grama, sand dropseed, and annual and perennial weeds. If overgrazing continues for many years, the less desirable plants increase; and as the protective cover provided by the more desirable plants decreases, sand movement increases and blowouts can develop.

These soils are well suited to trees and shrubs grown in windbreaks. Only species that can tolerate sandy, somewhat droughty soils should be planted. Inadequate available moisture and soil blowing are the main hazards. Soil blowing can be prevented by maintaining strips of sod or a cover between the rows. Competition from weeds and grasses can be controlled by mowing between the rows or by application of appropriate herbicides. Seedlings may need supplemental watering if rainfall is not sufficient.

These soils are generally suited to use as sites for dwellings and local roads and streets. If the soils are used as sites for septic tank absorption fields, care should be taken that nearby water supplies are not polluted by effluent seeping through the soil. The soils readily absorb effluent from septic tank systems but do not adequately filter the effluent. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving. In some places, small commercial buildings have to be designed to complement the slope, or the site has to be graded.

These soils are assigned to capability units VIe-5, dryland, and IVe-14, irrigated. The Pivot soils are in the Sandy range site and windbreak suitability group 5. The Valentine soils are in the Sands range site and windbreak suitability group 7.

SkB—Simeon loamy sand, 0 to 3 percent slopes. This deep, nearly level and very gently sloping, excessively drained soil is on uplands. Areas range from 20 to 500 acres or more in size.

Typically, the surface layer is dark grayish brown, very friable loamy sand about 4 inches thick. The subsurface layer is dark grayish brown, very friable sand about 5 inches thick. The next layer is brown, very friable sand about 10 inches thick. The underlying material is very pale brown sand to a depth of more than 60 inches and contains up to 3 percent gravel. In some areas, the underlying material contains strata of gravelly coarse sand.

Included with this soil in mapping are small areas of Meadin and Pivot soils. These soils are slightly lower on the landscape than Simeon soils. The Meadin soils are shallow to gravelly coarse sand. Pivot soils are moderately deep to coarse sand or gravelly coarse sand. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in this Simeon soil. The available water capacity is low. Organic matter content is low. Surface runoff is very slow, and the water intake rate is very high. This soil is easily tilled within a wide range in moisture content.

Most of the acreage of this soil is in native grass used as rangeland. A few areas are used for irrigated crops.

This soil is not suited to dryfarmed crops because it is too droughty and easily eroded by wind.

If this soil is irrigated, it is poorly suited to introduced grasses, corn, and alfalfa. Sprinkler irrigation is the only suitable method; areas of this soil are too sandy for gravity irrigation. Frequent, light applications of water are also needed to avoid leaching nutrients below the root zone. Control of soil blowing and maintenance of productivity are the principal management concerns. Maintaining large amounts of crop residue on the surface and keeping tillage to a minimum help to control soil blowing. Adding barnyard manure increases organic matter content and improves fertility. All crop residue should be returned to the soil.

This soil is suited to rangeland, and this use is effective in controlling soil blowing. The natural plant community is mostly sand bluestem, little bluestem, prairie sandreed, needleandthread, blue grama, and sand dropseed. If the plants are overgrazed, sand bluestem, little bluestem, and prairie sandreed decrease in abundance and blue grama, sand dropseed, and needleandthread increase. If overgrazing continues for many years, the less desirable plants that increase include sand dropseed, sand paspalum, hairy grama, plains pricklypear, and clubmoss.

This soil generally is unsuited to trees and shrubs planted in windbreaks because it is very droughty, and severe soil blowing is a hazard. Some areas can be used for recreation, forest, and wildlife plantings of tolerant trees and shrubs if special approved practices are used.

This soil is generally suited to use as building sites and as sites for local roads and streets. If this soil is used for septic tank absorption fields, care must be taken that nearby water supplies are not polluted by seepage. This soil readily absorbs effluent from septic tank systems but does not adequately filter it. Sewage lagoons need to be lined and sealed to prevent seepage. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving.

This soil is in capability units VIs-4, dryland, and IVs-14, irrigated, the Shallow to Gravel range site, and windbreak suitability group 10.

SmD—Simeon-Meadin complex, 0 to 9 percent slopes. This complex consists of nearly level to strongly sloping, excessively drained soils on uplands and side slopes along drainageways. Simeon soils are deep, sandy soils on mid and lower side slopes. Meadin soils are shallow to gravelly coarse sand and are on mid to upper side slopes and on ridgetops. Areas of this complex range from 20 to 300 acres in size. The Simeon soils make up about 45 to 50 percent of this complex, and Meadin soils make up about 35 to 45 percent. The individual areas of these soils are so mixed or so small that it is not practical to separate them at the scale used in mapping.

Typically, the Simeon soils have a surface layer of dark grayish brown, very friable loamy sand about 6 inches thick. Below this layer is dark brown, very friable coarse sand about 3 inches thick. The underlying material is coarse sand with gravel to a depth of more than 60 inches. It is pale brown in the upper part and very pale brown in the lower part.

Typically, the Meadin soils have a surface layer of dark grayish brown, very friable sandy loam about 3 inches thick. Below this layer is brown, friable sandy loam about 6 inches thick. The underlying material to a depth of more than 60 inches is pale brown gravelly coarse sand in the upper part and light brownish gray coarse sand with gravel in the lower part. In some areas, the dark surface layer is less than 7 inches thick.

Included with these soils in mapping are small areas of Brunswick, Duda, Pivot, Tassel, and Valentine soils. Brunswick and Duda soils are moderately deep to weathered sandstone, are well drained, and are on ridge slopes. Pivot soils are moderately deep to coarse sand and are somewhat excessively drained. They are in positions on the landscape similar to those of the major soils. Tassel soils are shallow to weathered sandstone and are on side slopes. Valentine soils are on higher landscapes and are deep, sandy soils. Included soils make up 10 to 15 percent of the complex.

Permeability is rapid in the Simeon soils. It is rapid in the upper part of the Meadin soils and very rapid in the lower part. The available water capacity is low in both soils. Organic matter content is low in the Simeon soils and moderately low in the Meadin soils. Runoff is slow on both soils. The water intake rate is high for both soils.

Most of the acreage of this complex is in native grass used for rangeland. A few areas are used for irrigated cropland.

These soils are unsuited to cultivated crops because they are too droughty and are easily eroded by wind. Also, Meadin soils are shallow to gravelly coarse sand.

These soils are suited to rangeland, and this use is effective in controlling soil blowing and water erosion. The natural plant community is sand bluestem, little bluestem, prairie sandreed, needleandthread, blue grama, and sand dropseed. If the plants are overgrazed, the sand bluestem, little bluestem, and prairie sandreed decrease, and blue grama, sand dropseed, and needleandthread increase. If overgrazing continues for many years, the less desirable plants increase, including sand dropseed, sand paspalum, hairy grama, plains pricklypear, and clubmoss.

These soils generally are unsuited to trees and shrubs planted in windbreaks because they are very droughty and severe soil blowing is a hazard. Some areas can be used for recreation, forestation, and wildlife plantings of tolerant trees and shrubs if special approved practices are used.

These soils are generally suited to use as building sites and as sites for local roads and streets. If these soils are used for septic tank absorption fields, care must be taken that effluent does not seep through the soil and contaminate nearby water supplies. These soils readily absorb effluent from septic tank systems but do not adequately filter it. Sewage lagoons need to be lined and sealed to prevent seepage. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving. Dwellings need to be properly designed to complement the slope, or the site can be graded.

These soils are assigned to capability unit VIs-4, dryland, the Shallow to Gravel range site, and windbreak suitability group 10.

SvG2—Simeon-Valentine sands, 9 to 60 percent slopes, eroded. This map unit consists of strongly sloping to very steep, excessively drained soils on breaks along major drainageways that drain into the Niobrara River. These areas are eroded by many small gullies. Areas range from 40 to 1,000 areas in size. Simeon sand makes up 50 to 60 percent of this complex, and Valentine sand makes up 25 to 40 percent. Simeon sand is on the upper side slopes and ridgetops, and Valentine sand is mostly on mid and lower side slopes.

Typically, the Simeon soil has a surface layer of light brownish gray, loose sand about 4 inches thick. The next layer is pale brown loose sand about 4 inches thick. The underlying material is white coarse sand to a depth of more than 60 inches. In some places, there are layers of gravelly coarse sand in the underlying material. In a few places, loamy material or shale is below a depth of 40 inches.

Typically, the Valentine soil has a surface layer of grayish brown, loose sand about 9 inches thick. The underlying material is sand to a depth of more than 60 inches. It is light brownish gray in the upper part and light gray in the lower part.

Included with these soils in mapping are small areas of Brunswick, Labu, Meadin, O'Neill, Pivot, Sansarc, and Tassel soils. Brunswick and Tassel soils are on the upper side slopes. They have sandstone in the underlying material. Brunswick soils are moderately deep to sandstone, and Tassel soils are shallow to sandstone. Labu and Sansarc soils developed in clayey material weathered from shale and generally are on lower landscape positions. Labu soils are moderately deep to bedded shale, and Sansarc soils are shallow to bedded shale. Meadin, O'Neill, and Pivot soils have a thicker, dark surface layer and are higher on the landscape. Meadin soils are shallow over gravelly coarse sand. O'Neill and Pivot soils are moderately deep to gravelly coarse sand or coarse sand. O'Neill soils have a heavier textured subsoil. Included soils make up as much as 10 to 15 percent of the map unit.

In the Simeon and the Valentine sands, permeability is rapid, and the available water capacity is low. Both soils have low organic matter content. Surface runoff is slow to medium.

Most areas are in native grass used for grazing. The soils are unsuited to cropland because of the steep slope and severe susceptibility to soil blowing and water erosion.

These soils are suited to rangeland, and this use is effective in controlling soil blowing and water erosion. The natural plant community is mostly sand bluestem, little bluestem, prairie sandreed, sand lovegrass, switchgrass, needleandthread, blue grama, and sand dropseed. If the plants are overgrazed, sand bluestem, little bluestem, and prairie sandreed decrease, and blue grama, sand dropseed, and needleandthread increase. If overgrazing continues for many years, the less desirable plants increase, including sand dropseed, sand paspalum, hairy grama, plains pricklypear, and clubmoss.

The only parts of this map unit suited to trees and shrubs planted in windbreaks are areas of the Valentine soil having slope of less than 17 percent. Generally, these soils are too droughty, too sandy, and too steep to provide good sites for planting trees. Trees need to be planted in shallow furrows, with as little disturbance of the soil as possible. Some areas can be used for recreational and wildlife plantings of tolerant trees or shrubs if they are hand planted or other special approved practices are used.

If these soils are used for septic tank absorption fields, care should be taken that pollution by seepage does not contaminate nearby water supplies. These soils readily absorb effluent from septic tank systems but do not adequately filter the effluent. Land shaping and installing the septic tank absorption field on the contour generally are necessary for proper operation. If the slope is greater than 15 percent, the soils are not suitable for

sanitary facilities. A suitable alternate site is needed. If sewage lagoons are constructed, extensive grading is required to modify the slope and shape the lagoon. Sewage lagoons need to be lined or sealed to prevent seepage. The walls and sides of shallow excavations can be temporarily shored to prevent sloughing or caving. Slope increases the difficulty of digging. Dwellings should be properly designed to complement the slope, or the site can be graded. Cuts and fills generally are needed to provide a suitable grade for roads and streets.

These soils are assigned to capability unit VIs-4, dryland. The Simeon soil is in the Shallow to Gravel range site, and the Valentine soil is in the Sands range site. Both soils are in windbreak suitability group 10.

TdG—Tassel-Valentine-Duda complex, 15 to 70 percent slopes. This complex consists of moderately steep to very steep soils on upland breaks to the Niobrara River Valley. Most areas are dissected by drainageways. The shallow, somewhat excessively drained Tassel soils make up 30 to 40 percent of this complex. The deep, excessively drained Valentine soils make up about 25 to 35 percent, and the moderately deep, well drained Duda soils make up about 20 to 30 percent. Areas of this complex range from 300 to 500 acres in size. The individual areas of these soils are so intricately mixed or so small that it is not practical to separate them at the scale used in mapping.

Typically, the Tassel soils have a surface layer of dark grayish brown, very friable loamy sand about 2 inches thick. The underlying material, about 17 inches thick, is light brownish gray loamy sand in the upper part and very pale brown fine sandy loam in the lower part. Very pale brown, calcareous sandstone is at a depth of 19 inches.

Typically, the Valentine soils have a surface layer of dark grayish brown, very friable loamy fine sand about 3 inches thick. The next layer is grayish brown, very friable loamy fine sand about 4 inches thick. The underlying material is very pale brown fine sand to a depth of more than 60 inches. In some areas, the dark surface layer is thicker than 10 inches. In some areas, the underlying material is sand or coarse sand with gravel.

Typically, the Duda soils have a surface layer of grayish brown, very friable loamy sand about 6 inches thick. The next layer is light brownish gray, very friable loamy sand about 9 inches thick. The underlying material, about 17 inches thick, is pale brown and light gray, very friable loamy sand. White sandstone is at a depth of 32 inches. In some areas, the solum is sandy loam or fine sandy loam.

Included with these soils in mapping are areas of Barney, Boel, Labu, Meadin, and Sansarc soils. Barney and Boel soils are on bottom lands. Barney soils are poorly drained, and Boel soils are somewhat poorly drained. Labu and Sansarc soils formed in clay weathered from shale and are on lower side slopes. Labu soils are moderately deep to bedded shale, and Sansarc soils are shallow to bedded shale. Meadin soils are shallow to sand and gravel material and are on upper side slopes near the top of the breaks. Included soils make up less than 15 percent of the map unit.

Permeability is moderately rapid in Tassel soils and rapid in Valentine and Duda soils. The available water capacity is very low in Tassel soils and low in Valentine and Duda soils. The organic matter content is low in all those soils. Roots are restricted by the sandstone, but tree roots can find cracks to penetrate.

All the soils are in native vegetation, which is grass and trees. Wooded areas on the upper slopes generally consist of cedar and ponderosa pine. They are thick enough to shade out the grass on some slopes. Oak, ash, and other broadleaf trees generally are along the base of most drainageways. These areas generally are used for summer grazing. The soils in this complex are unsuited to use as cropland.

These soils are suited to rangeland. The major concerns of range management are the hazard of erosion and droughtiness. The soils are somewhat droughty because the available water capacity is low and water is lost as runoff. The natural plant community is mostly tall and mid grasses, shrubs, and trees dominated by big bluestem or sand bluestem, little bluestem, sideoats grama, plains muhly, prairie sandreed, needleandthread, ponderosa pine, redcedar, and bur oak. In overgrazed areas, the grasses decrease, resulting in a rapid increase of bur oak, ponderosa pine, and shrubs.

These soils generally are not suitable for sanitary facilities and building sites because of the steep slope and moderate to shallow depth to sandstone. A suitable alternate site is needed. Cuts and fills generally are needed to provide a suitable grade. Soft bedrock has to be excavated for roads and streets.

These soils are assigned to capability unit VIIs-4, dryland, and windbreak suitability group 10. The Tassel soil is in the Shallow Limy range site. Valentine soils are in the Sands range site. Duda soils are in the Savannah range site.

Tn—Tryon loamy fine sand, 0 to 2 percent slopes. This soil is deep, nearly level, and poorly drained. It is in valleys in sandhill areas. It is rarely flooded. Areas range from 20 to 100 acres or more in size.

Typically, the surface layer is dark gray, very friable loamy fine sand about 5 inches thick. The next layer is light brownish gray, loose loamy sand about 5 inches thick. The underlying material to a depth of more than 60 inches is light gray, mottled, loose sand in the upper part; grayish brown, mottled, very friable fine sand in the middle part; and gray and light gray, loose sand in the lower part. In some places, the dark surface soil is more than 10 inches thick.

Included with this soil in mapping are small areas of Els, Elsmere, Ipage, and Marlake soils. Els and Elsmere soils are somewhat poorly drained soils on the higher, hummocky areas. Elsmere soils have a dark surface layer more than 10 inches thick. Ipage soils are moderately well drained on the highest areas of this map unit. Marlake soils are in depressions and have water on the surface during most of the growing season. The soils near the edge of some depressions are severely affected by alkali. Included soils make up 5 to 15 percent of the map unit.

In this Tryon soil, permeability is rapid. The available water capacity is low. Organic matter content is high. Runoff is very slow. The seasonal high water table ranges from at the surface in wet years to within a depth of about 1.5 feet in dry years. It normally recedes to a depth of about 2 to 3 feet in late summer.

Most of the acreage of this soil is in rangeland and is either grazed or used for hayland.

This soil is too wet for use as cropland. It is suited to rangeland and native hay. The natural plant community is mostly tall and mid grasses and grasslike plants dominated by switchgrass, indiangrass, big bluestem, prairie cordgrass, and various sedges. If the plants are overgrazed or improperly harvested for hay, the soil may be dominated by timothy, redtop, foxtail barley, clover, sedges, and rushes. When the soil is wet, overgrazing can cause surface compaction and small mounds, making it difficult to harvest for hay.

If the soil is used for native hay, mowing needs to be regulated so that the grasses remain vigorous and keep their place in the meadow. In order to allow for carbohydrate storage in plants in meadows, mowing needs to be avoided between boot stage and seed maturity. Large areas can be divided into three parts and mowed in rotation. One-third should be mowed about 2 weeks before plants reach the boot stage, one-third at boot stage, and one-third in the early flowering period. The areas should be rotated in successive years. If a rancher has plenty of hay, the entire area may be left idle 1 year in 3, particularly if the rotation mowing plan is not followed. After frost and during winter, range animals usually can graze without damaging meadows if the areas are not overstocked. Livestock must be removed before the frost disappears and the water table reaches a high level.

This soil is poorly suited to trees and shrubs in windbreaks. Wetness from the high water table is the main limitation. Only the trees and shrubs tolerant of a high water table are suited to this soil. Preparation of the soil and planting trees in the spring may not be possible until the water table recedes and the soil is sufficiently dry. The weeds and undesirable grasses can be controlled by cultivating between the rows when the water table is lowest or by using appropriate herbicides. Areas close to trees can be rototilled or hoed by hand.

This soil is not suited to sanitary facilities and dwellings because of wetness. A suitable alternate site is needed. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving if the shoring is done during dry seasons. Small commercial buildings can be constructed on well-compacted fill material to overcome wetness caused by the high water table and as protection against flooding. Constructing roads and streets on suitable, well-compacted fill material and providing adequate side ditches and culverts help to protect the roads from wetness.

This soil is assigned to capability unit Vw-7, dryland, the Wet Subirrigated range site, and windbreak suitability group 2D.

To—Tryon loamy fine sand, wet, 0 to 2 percent slopes. This soil is deep, nearly level, and very poorly drained. It occurs on valley floors in sandhill areas and on bottom lands along some of the major streams that drain from the sandhills. This soil is rarely flooded but is occasionally ponded because of a very high water table in the spring and during wet periods. Areas range from 20 to 100 acres in size.

Typically, the surface layer consists of gray, loose loamy fine sand about 6 inches thick. Below this is light gray, very friable fine sand about 9 inches thick. The underlying material to a depth of about 60 inches is fine sand. It is mottled, light gray in the upper part, mottled gray in the middle part, and white in the lower part. At a depth of 40 inches, the underlying material is interrupted by a 4-inch layer of light brownish gray loamy fine sand. In some places, the dark surface layer is more than 10 inches thick.

Included with this soil in mapping are small areas of Els, Elsmere, Ipage, and Marlake soils. Els and Elsmere soils are somewhat poorly drained soils on slightly higher, mostly hummocky areas. Elsmere soils have a dark surface soil more than 10 inches thick. Ipage soils are moderately well drained soils on higher hummocky areas. Marlake soils have a stratified surface layer and are ponded during much of the growing season. Included areas make up 5 to 15 percent of the unit.

Permeability in this Tryon soil is rapid. The available water capacity is low. Organic matter content is high. Runoff is very slow. The seasonal high water table ranges from about 0.5 foot above the surface in wet years to a depth of about 1.0 foot in dry years. Water may be on the surface for a week or more at a time during wet periods. By late summer, it normally recedes to a depth of about 1 to 2 feet.

Most of the acreage of this soil is in rangeland and is grazed or harvested for hay. This soil is too wet for cultivation.

This soil is suited to rangeland and native hay. The natural plant community is mostly tall and mid grasses and grasslike plants dominated by prairie cordgrass,

bluejoint reedgrass, northern reedgrass, and various sedges. If the plants are overgrazed or improperly harvested for hay, the site may be dominated by timothy, redtop, foxtail barley, red clover, sedges, and rushes. If the plants are grazed during early spring, small mounds will develop, making it difficult to harvest for hay.

Mowing needs to be regulated so the grasses remain vigorous when the soil is used for hayland. The high water table has drowned out most of the bluestem, switchgrass, and indiangrass. In some years forage cannot be harvested because of wetness. Some hay meadows can be improved by installing V-shaped ditches to hasten surface drainage and by seeding reed canarygrass into the existing vegetation. A proper mowing sequence should be followed. The meadow should be mowed before the dominant grasses reach the boot stage. Mowing should be avoided between boot stage and seed maturity. After frost and during winter, livestock can graze without damaging the meadows if the areas are properly stocked. Range animals must be removed before the frost moves out of the soil and the water table reaches a high level.

This soil is unsuited to windbreak plantings of trees and shrubs because of wetness caused by the high water table. A few areas can be used for recreational, wildlife, or forest plantings of tolerant trees or shrubs if hand planting or other special approved practices are used.

This soil is not suited to septic tank absorption fields, sewage lagoons, and dwellings because of wetness and ponding. A suitable alternate site is needed. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving if the shoring is done during the dry season. Small buildings can be constructed on fill material to overcome ponding caused by the high water table and for protection against flooding. Constructing roads and streets on suitable, well-compacted fill material above the ponding level and providing adequate side ditches and culverts help protect roads from damage by ponding and wetness.

This soil is assigned to capability unit Vw-7, the Wetland range site, and windbreak suitability group 10.

TpB—Tryon-Els loamy sands, 0 to 3 percent slopes. This complex consists of deep, nearly level and very gently sloping soils on bottom lands of the Elkhorn River Valley. This unit is rarely flooded. Tryon loamy sand is poorly drained and nearly level. Els loamy sand is somewhat poorly drained and nearly level to very gently sloping. Areas of this complex range from 40 to 600 acres in size. About 45 to 50 percent of this complex is Tryon loamy sand, and 45 to 50 percent is Els loamy sand. The individual areas of these two soils are so mixed or so small that it is not practical to separate them at the scale used in mapping (fig. 9).

Typically, the Tryon soil has a surface layer of dark gray, very friable loamy sand about 8 inches thick. The upper part of this surface layer is calcareous. The underlying material is mottled fine sand to a depth of more than 60 inches. It is light brownish gray in the upper part and light gray in the lower part. In a few places, the dark surface layer is thicker than 10 inches. Also, in a few low areas, occasional ponding may occur during wet periods.

Typically, the Els soil has a surface layer of dark grayish brown, very friable loamy sand about 7 inches thick. The next layer is about 7 inches of grayish brown, very friable sand. The underlying material is sand to a depth of more than 60 inches. It is light brownish gray in the upper part and white in the lower part and is mottled from the surface to a depth of 24 inches. In a few areas, the dark surface layer is thicker than 10 inches.

Included with these soils in mapping are small areas of Ipage and Marlake soils. Ipage soils are moderately well drained soils on the higher hummocky areas. Marlake soils have a stratified surface layer, are on the lowest part of the landscape, and are ponded during much of the growing season. Also included in this complex are small areas of alkali soils. Included soils make up 5 to 10 percent of the map unit.

In the Tryon and Els loamy sands, permeability is rapid. The available water capacity is low. The organic matter content is high in the Tryon soil and moderately low in the Els soil. The seasonal high water table of the Tryon soil ranges from the surface in wet years to about 1.5 feet below the surface in dry years. The seasonal high water table of the Els soil ranges from 1.5 feet in wet years to 3.0 feet in dry years. Runoff is slow to very slow for both soils.

Nearly all the acreage is in native grasses and is used for native hayland. Some smaller areas are used as rangeland.

This complex is unsuitable for cultivation because approximately half the acreage is too wet during the growing season for any type of tillage operations.

These soils are suited to rangeland and native hay. Approximately 50 percent of the acreage is in the Subirrigated range site, and 50 percent is in the Wet Subirrigated range site. The variability of the range sites within the unit makes proper grazing use difficult to achieve. The natural plant community is mostly tall and mid grasses, grasslike plants, and various sedges. Areas of Tryon soil are dominated by switchgrass, indiangrass, big bluestem, and prairie cordgrass. The range areas of Els soil are dominated by big bluestem, little bluestem, indiangrass, switchgrass, and prairie cordgrass. If the plants are overgrazed or improperly harvested for hay, the sites are dominated by timothy, redtop, foxtail barley, clover, sedges, and rushes. If the soils are grazed during early spring, small mounds will develop, making it difficult to harvest for hay.

The soils in this unit can be used as sites for planting trees and shrubs in windbreaks. The Tryon soil is poorly suited as a site for planting trees and shrubs; only trees

Figure 9.—This area of Tryon-Els loamy sands, 0 to 3 percent slopes, is in native grass and is used for hayland. Els loamy sand, in the Subirrigated range site, is in the foreground. Tryon loamy sand, in the Wet Subirrigated range site, and ponded areas are in the background.

and shrubs tolerant of a very high water table are suited to this soil. The Els soil is suited as a site for planting trees and shrubs; only trees and shrubs tolerant of a moderately high water table are suited. Establishment of trees can be a problem in wet years on this unit. Vigorous grass or weed competition on this soil is a concern of management. If possible, ground preparation as much as one year before planting, and control of grasses and weeds by cultivation, mowing, or use of herbicides for several years after planting will increase tree survival and speed tree growth.

The Tryon soil is not suited to sanitary facilities because of wetness. The Els soil readily absorbs effluent from septic tank systems but does not adequately filter the effluent. The poor filtering capacity may result in pollution of the ground water. If sewage lagoons are constructed on Els soil, fill material should be used to raise the bottom of the lagoon to a sufficient height above the seasonal high water table. Sewage lagoons need to be lined or sealed to prevent seepage and diked as protection against ponding. The walls or sides of shallow excavations in these soils can be temporarily shored to prevent sloughing or caving if the shoring is done during the dry season. Sites for dwellings and other buildings should be raised with well-compacted fill material because of the high water table and the flood hazard. Constructing roads on suitable, well-compacted fill material and providing adequate side ditches and culverts help protect roads from flood damage and wetness from the seasonal water table. Road damage caused by frost action can be reduced by providing good surface drainage and by using a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

These soils are assigned to capability unit Vw-7, dryland. The Tryon soil is in the Wet Subirrigated range site and windbreak suitability group 2D. The Els soil is in

the Subirrigated range site and windbreak suitability group 2S.

VaB—Valentine fine sand, 0 to 3 percent slopes. This soil is deep, excessively drained, and nearly level and very gently sloping. It occurs in enclosed valleys within the sandhills and on uplands. It occupies mostly low, hummocky areas that range from 20 to 200 acres or more in size.

Typically, the surface layer is dark grayish brown, loose fine sand about 3 inches thick. The next layer is brown, loose fine sand about 5 inches thick. The underlying material is pale brown fine sand to a depth of more than 60 inches. In some of the concave and lower areas, the dark surface layer is thicker than 10 inches.

Included with this soil in mapping are small areas of Els and Ipage soils. Els soils, which are in the valleys or swales, are affected by a seasonal high water table. Ipage soils are slightly lower on the landscape than the Valentine soils and are moderately well drained. Also included with this soil in mapping are a few small areas of blown-out land. The inclusions make up less than 15 percent of the unit.

Permeability in this Valentine soil is rapid. The available water capacity is low. Organic matter content is low. The water intake rate is very high, and runoff is slow.

Most of the acreage of this soil is in native grass and is used for range or hayland. A few areas are used for irrigated cropland.

This soil is unsuitable for dryfarming because of droughtiness and the hazard of soil blowing.

If irrigated, this soil is poorly suited to corn, alfalfa, and introduced grasses. It is unsuited to gravity methods of irrigation but can be sprinkler irrigated. Water should be applied frequently and in small amounts to prevent leaching of plant nutrients. Soil blowing is a hazard if the surface is not adequately protected by growing crops or crop residue. Using close-growing crops, leaving crop residue on the surface, and using winter cover crops help to control soil blowing. Adding barnyard manure helps to maintain fertility and increase the organic matter content. Grazing of crop residue should be restricted to ensure maximum crop residue cover.

This soil is suited to rangeland, and this use is very effective in controlling soil blowing and water erosion. The natural plant community is dominated by sand bluestem, little bluestem, prairie sandreed, switchgrass, and needleandthread. If the plants are overgrazed or improperly harvested for hay, the site may be dominated by Scribner panicum, blue grama, and numerous annual and perennial weeds.

This soil is suited to trees and shrubs planted in windbreaks. The soil is so loose that trees planted in windbreaks need to be planted in shallow furrows with as little disturbance of the soil as possible. Young seedlings can be damaged by high winds and can be covered by drifting sand. Weeds and undesirable grasses near the trees can be controlled by timely use of herbicides or cultivation.

This soil generally is suited to use as sites for dwellings and local roads and streets. If this soil is used for septic tank absorption fields, care should be taken to be certain that pollution by seepage does not contaminate nearby water supplies. The soil readily absorbs effluent from septic tank systems but does not adequately filter it. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving.

This soil is assigned to capability units VIe-5, dryland, and IVe-12, irrigated, the Sandy range site, and windbreak suitability group 7.

VaD—Valentine fine sand, 3 to 9 percent slopes. This soil is deep, gently sloping to strongly sloping, and excessively drained. It occurs on uplands and in sandhills. Individual areas range from 20 to 640 acres in size.

Typically, the surface layer is grayish brown, loose fine sand about 3 inches thick. The next layer is brown, loose fine sand about 5 inches thick. The underlying material is pale brown fine sand to a depth of more than 60 inches. On a few of the concave and lower slopes, the soil has a dark surface layer thicker than 10 inches.

Included with this soil in mapping are small areas of Els and Ipage soils, on lower positions, and some small blowouts. Els soils are somewhat poorly drained. Ipage soils are moderately well drained. Inclusions make up 10 to 15 percent of this unit.

Permeability in this Valentine soil is rapid. The available water capacity is low. The organic matter content is low. The water intake rate is very high. Runoff is slow.

About two-thirds of the acreage of this soil is in native grass used for rangeland. The remaining areas are cultivated and irrigated by sprinkler systems.

This soil is unsuitable for dryfarming because of droughtiness and the hazard of soil blowing.

Under irrigation this soil is poorly suited to corn, alfalfa, small grains, and introduced grass where slopes do not exceed 6 percent. It is suited to alfalfa, small grains, and introduced grasses where slopes are 6 to 9 percent. This soil is not suitable for gravity methods of irrigation but can be sprinkler irrigated. Frequent, light applications of water are needed to avoid excessive leaching of plant nutrients. Soil blowing is a hazard in areas where the surface is not adequately protected by growing crops or crop residue. Using close-growing crops, leaving crop residue on the surface, and using winter cover crops help control soil blowing. In order to obtain maximum cover, removal of crop residue should be limited and grazing of the residue should be restricted. Barnyard

manure helps to maintain fertility and the organic matter content.

This soil is suited to rangeland, and this use is very effective in controlling soil blowing and water erosion. The natural plant community is mostly tall and mid grasses dominated by sand bluestem, little bluestem, prairie sandreed, sand lovegrass, switchgrass, and needleandthread. If the plants are overgrazed or improperly harvested for hay, sand bluestem, little bluestem, switchgrass, and sand lovegrass decrease, and needleandthread, prairie sandreed, blue grama, sand dropseed, and sandhill muhly increase. If overgrazing continues for many years, the less desirable plants increase, sand movement increases, and blowouts can develop.

This soil is suited to planting trees and shrubs in windbreaks. It is so loose that trees need to be planted in shallow furrows with as little disturbance of the soil as possible. Young seedlings may be damaged by sand blasting or may be covered by drifting sand during high winds. Maintaining strips of sod or other vegetation between the rows reduces soil blowing and helps to control weeds. Weeds and grass in areas near the trees can be controlled by using the appropriate herbicides or by hand cultivation.

This soil generally is suited to use as a site for dwellings and local roads and streets. If this soil is used for septic tank absorption fields, care should be taken to be certain that pollution by seepage does not contaminate nearby water supplies. The soil readily absorbs effluent from septic tank systems but does not adequately filter the effluent. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving. In some places, small commercial buildings may need to be properly designed to complement the slope, or the site may need to be graded.

This soil is assigned to capability unit VIe-5, dryland, and IVe-12, irrigated, the Sands range site, and windbreak suitability group 7.

VaE—Valentine fine sand, rolling. This soil is deep and excessively drained. Slopes range from 9 to 17 percent. The soil is on hummocky dunes in the sandhills. Individual areas range from 40 to several thousand acres in size.

Typically, the surface layer is grayish brown, loose fine sand about 4 inches thick. The next layer is brown, loose fine sand about 6 inches thick. The underlying material is pale brown fine sand to a depth of more than 60 inches.

Included with this soil in mapping are small areas of Brunswick, Els, and Ipage soils. Brunswick soils have a finer textured solum are moderately deep to weathered sandstone and are on the upper side slopes. The somewhat poorly drained Els soils are in swales and have a seasonal high water table. Ipage soils are moderately well drained and are lower on the landscape. Small blowouts are common. The inclusions make up 10 to 15 percent of the unit.

Permeability in this Valentine soil is rapid. The available water capacity is low. Organic matter content is low. Runoff is slow.

Areas of this soil are in native grass used mostly for rangeland. A few of the lower areas are periodically cut for hay. In recent years, some areas have been developed as irrigated cropland.

This soil is unsuitable for dryfarmed or irrigated cropland because of the steepness of slope. This soil is suited to rangeland, and this use is very effective in controlling soil blowing and water erosion. The natural plant community is mostly tall and mid grasses dominated by sand bluestem, little bluestem, prairie sandreed, sand lovegrass, switchgrass, and needleandthread (fig. 10). In overgrazed areas, sand bluestem, little bluestem, switchgrass, and sand lovegrass decrease, and needleandthread, prairie sandreed, blue grama, sand dropseed, and sandhill muhly increase. If overgrazing continues for several years, the less desirable plants increase; and as the protective cover provided by the more desirable plants decreases, sand movement increases and blowouts can develop.

This soil is suited to planting trees and shrubs in windbreaks. The soil is so loose that trees need to be planted in shallow furrows with as little disturbance of the soil as possible. Strips of sod or other vegetation need to be maintained between the tree rows to control soil blowing. Young seedlings may be damaged by sand blasting during high winds and may be covered by drifting sand. Weeds and undesirable grasses can be controlled by hand cultivation or by using the appropriate herbicides.

If this soil is used for septic tank absorption fields, care should be taken to be certain that pollution by seepage does not contaminate nearby water supplies. This soil readily absorbs effluent from septic tank systems but does not adequately filter the effluent. Sewage lagoons need to be lined or sealed to prevent seepage. Grading is needed to modify the slope and shape sewage lagoons. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving. Dwellings should be properly designed to complement the slope, or the site can be graded. Cuts and fills generally are needed to provide a suitable grade for roads and streets.

This soil is assigned to capability unit VIe-5, dryland, the Sands range site, and windbreak suitability group 7.

VaG—Valentine fine sand, rolling and hilly. This soil is deep and excessively drained. It occurs on rolling and hilly sandhills. The hilly part is steeper and commonly higher in elevation than the rolling part. Most of the very steep areas have irregular catsteps on the side slopes.

Slopes range from 14 to 60 percent. Areas range from 40 to 1,000 acres in size.

Typically, the surface layer is brownish gray, loose fine sand about 3 inches thick. The underlying material is pale brown fine sand to a depth of more than 60 inches.

Included with this soil in mapping are small areas of Els and Ipage soils, which are lower on the landscape. Ipage soils are moderately well drained. Els soils are somewhat poorly drained. Also included are a few blowouts. The inclusions make up less than 10 percent of the unit.

Permeability in the Valentine soil is rapid. The available water capacity is low. Organic matter content is low. Runoff is slow.

Areas of this soil are in native grass used for range. This soil is unsuitable for crops because of the steep slope.

This soil is suited to rangeland, and this use is very effective in controlling soil blowing and water erosion. The natural plant community is mostly tall and mid grasses dominated by sand bluestem, little bluestem, switchgrass, prairie sandreed, and sand lovegrass (fig. 11). If the plants are overgrazed, the native grasses lose vigor and are unable to stabilize the area, resulting in the developing or enlargement of blowouts.

This soil generally is unsuited to trees and shrubs in windbreaks. Some areas can be used for recreational and wildlife plantings of tolerant trees or shrubs if hand planting or other special approved practices are used. Onsite investigation may bring out small areas suitable for plantings.

This Valentine soil generally is not suitable for sanitary facilities because of the steep slope; a suitable alternate site is needed. The walls or sides of shallow excavations can be temporarily shored to keep the soil from sloughing or caving. Slope increases the difficulty of digging. Dwellings should be properly designed to complement the slope, or the site can be graded. Cuts and fills generally are needed to provide a suitable grade for roads and streets.

This soil is assigned to capability unit VIIe-5, dryland, and windbreak suitability group 10. The rolling areas are

Figure 10.—Sands range site in an area of Valentine fine sand, rolling.

Figure 11.—Sands and Choppy Sands range sites in an area of Valentine fine sand, rolling and hilly.

in the Sands range site. The hilly areas are in the Choppy Sands range site.

VbB—Valentine loamy fine sand, 0 to 3 percent slopes. This deep, nearly level and very gently sloping, excessively drained soil is on uplands. Areas range from 15 to 640 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 7 inches thick. The next layer is brown, loose fine sand about 8 inches thick. The underlying material is pale brown fine sand to a depth of more than 60 inches. In some places, the dark surface layer is more than 10 inches thick.

Included with this soil in mapping are small areas of Boelus, Els, Ipage, O'Neill, and Pivot soils. Boelus, O'Neill, and Pivot soils are slightly lower on the landscape than the Valentine soils. The Boelus soils have loamy underlying material. Els and Ipage soils are on lower landscape positions. Els soils are somewhat poorly drained, and Ipage soils are moderately well drained. O'Neill and Pivot soils have a dark surface layer more than 10 inches thick and are moderately deep to sand and gravel. O'Neill soils also have a finer textured subsoil. Included soils make up 10 to 15 percent of this unit.

In this Valentine soil, permeability is rapid. The available water capacity is low. Organic matter content is low. This soil has a very high intake rate. Runoff is slow.

Most areas of this soil are in native grass and are used for range or hayland. The remaining acreage is cropland, and most of the cropland is irrigated by sprinkler systems.

If dryfarmed, this soil is poorly suited to corn, small grains, and alfalfa. Small grains and first-cutting alfalfa generally are the better suited crops because they grow and mature in spring when the rainfall is highest. Soil blowing is a hazard if the surface is not adequately protected by growing crops or crop residue. Soil blowing can be reduced, moisture conserved, and organic matter content and fertility maintained by using a cropping

system that keeps the soil covered with crops, grass, or crop residue. The number of row crops needs to be limited in the cropping sequence, and maximum use should be made of close-growing crops that protect the soil and conserve moisture. Stripcropping and stubble-mulch tillage can be used to control soil blowing. Returning crop residue to the soil and using barnyard manure help to increase the organic matter content and improve fertility.

If this soil is irrigated, it is suited to corn, alfalfa, small grains, and introduced grasses. Sprinkler irrigation is the only suitable method. The soil is too sandy for gravity irrigation. Frequent applications of water are needed because the available water capacity is low, and light applications are needed to avoid leaching plant nutrients below the root zone. Soil blowing is a hazard if the surface is not adequately protected by growing crops or crop residue. Using stubble-mulch tillage and winter cover crops helps control soil blowing. Returning crop residue to the soil increases the organic matter content and helps maintain fertility.

This soil is suited to rangeland, and this use is very effective in controlling soil blowing and water erosion. The natural plant community is dominated by sand bluestem, little bluestem, prairie sandreed, switchgrass, and needleandthread. If the plants are overgrazed or improperly harvested for hay, the site may be dominated by Scribner panicum, blue grama, and numerous annual and perennial weeds.

This soil is suited to planting trees and shrubs in windbreaks. Only trees and shrubs tolerant of sandy, droughty conditions are suited. Irrigation can provide supplemental water during droughts. Soil blowing can be controlled by maintaining strips of sod or other vegetation between the rows. Weeds and undesirable grasses in the tree rows can be controlled by using the appropriate herbicides or by hand cultivation.

This soil generally is suited to use as a site for dwellings and local roads and streets. If it is used for septic tank absorption fields, care should be taken that nearby water supplies are not polluted by effluent seeping through the soil. The soil readily absorbs effluent from septic tank systems but does not adequately filter the effluent. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving.

This soil is assigned to capability units IVe-5, dryland, and IVe-11, irrigated, the Sandy range site, and windbreak suitability group 5.

VbD—Valentine loamy fine sand, 3 to 9 percent slopes. This deep, gently sloping and strongly sloping, excessively drained soil is on uplands and sandhills. Areas range from 20 to 800 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 6 inches thick. The next layer is grayish brown, very friable loamy fine sand about 6 inches thick. The underlying material is pale brown and light gray fine sand and sand to a depth of more than 60 inches.

Included with this soil in mapping are small areas of Boelus, Brunswick, Els, Ipage, and Wewela soils. Boelus soils are in swales and have loamy underlying material. Brunswick soils are moderately deep to weathered sandstone and are well drained. Brunswick soils are on the upper part of side slopes. Els and Ipage soils are lower on the landscape. Els soils are somewhat poorly drained, and Ipage soils are moderately well drained. Wewela soils are lower on the landscape and are underlain by shale within a depth of 40 inches. Included soils make up 10 to 15 percent of this unit.

Permeability in this Valentine soil is rapid. The available water capacity is low. Organic matter content is low. This soil has a very high water intake rate, and runoff is slow.

About two-thirds of the acreage is in native grass and is used for grazing. The remainder is used mostly for irrigated cropland.

This soil generally is unsuitable for dryfarmed cropland because of droughtiness and the hazard of soil blowing. Some areas, however, are being cultivated along with larger areas of arable soils.

If this soil is irrigated, it is poorly suited to corn alfalfa, introduced grasses, and small grains. Sprinkler irrigation is the only method. The soil is too sandy for gravity irrigation. Frequent, light applications of water to prevent leaching of plant nutrients below the root zone are needed. Soil blowing is a hazard if the surface is not adequately protected by growing crops or crop residue. Corn stalks need to be managed so that the maximum crop residue remains on the surface to reduce soil blowing in the winter and spring. In order to obtain maximum cover, removal of the crop residue should be limited and grazing of the crop residue should be restricted. Stubble-mulch tillage and using winter cover crops help control soil blowing. Keeping tillage to a minimum, using field windbreaks, and applying fertilizer for maximum crop production help control soil blowing and maintain fertility (fig. 12).

This soil is suited to rangeland, and this use is very effective in controlling soil blowing and water erosion. The natural plant community is dominated by sand bluestem, little bluestem, prairie sandreed, sand lovegrass, switchgrass, and needleandthread. If the plants are overgrazed or improperly harvested for hay, sand bluestem, little bluestem, switchgrass, and sand lovegrass decrease, and needleandthread, prairie sandreed, blue grama, sand dropseed, and other annual and perennial weeds increase. If overgrazing continues for many years, the less desirable plants increase; and as the protective cover provided by the more desirable plants decreases, sand movement increases and blowouts can develop.

Figure 12.—Cornstalk residue on Valentine loamy fine sand, 3 to 9 percent slopes. Crop residue left on the surface helps to control soil blowing and catches drifting snow, which provides soil moisture.

This soil is suited to planting trees and shrubs in windbreaks. This soil is so loose that trees need to be planted in shallow furrows with as little disturbance of the soil as possible. Young seedlings may be damaged by sand blasting or may be covered with drifting sand during high winds. Maintaining strips of sod or other vegetation between the rows reduces soil blowing and helps conserve moisture by controlling weeds and undesirable grasses. Weeds in areas near the trees can be controlled by using the appropriate herbicides or by hand cultivation.

This soil generally is suited to use as a site for dwellings and local roads and streets. If this soil is used for septic tank absorption fields, care should be taken to be certain that pollution by seepage does not contaminate nearby water supplies. This soil readily absorbs effluent from septic tank systems but does not adequately filter the effluent. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving.

This soil is assigned to capability units VIe-5, dryland, and IVe-11, irrigated, the Sands range site, and windbreak suitability group 7.

VdD—Valentine-Boelus fine sands, 0 to 9 percent slopes. This complex consists of deep, excessively drained, gently sloping to strongly sloping Valentine fine sand and deep, well drained, nearly level Boelus fine sand. Areas of this complex are on uplands and range from 25 to 100 acres in size. This complex is 45 to 55 percent Valentine fine sand and 40 to 50 percent Boelus fine sand. The Valentine soil is on the convex hummocky areas. The Boelus soil is on the concave and lower positions. The individual areas of the two soils are so

mixed or so small that it is not practical to separate them at the scale used in mapping.

Typically, the Valentine soil has a surface layer of dark grayish brown, very friable fine sand about 6 inches thick. Below this is grayish brown, loose fine sand about 7 inches thick. The underlying material is pale brown fine sand to a depth of more than 60 inches. In some areas, coarse sand is below a depth of 40 inches.

Typically, the Boelus soil has a surface layer of grayish brown, loose fine sand about 12 inches thick. Next is a layer of pale brown fine sand about 24 inches thick. Beneath this is a buried subsoil of grayish brown, firm loam about 16 inches thick. The underlying material is very pale brown coarse sand that extends to a depth of more than 60 inches.

Included with these soils in mapping are Jansen and Meadin soils. Jansen and Meadin soils are in positions on the landscape similar to those of the Boelus soils. Jansen soils have a finer textured surface layer and subsoil. Meadin soils are shallow to sand and gravel. Also included are areas where cultivation has exposed the finer textured subsoil or even the underlying gravelly sand material. Included soils make up about 5 to 10 percent of the complex.

The Valentine soil has rapid permeability. The available water capacity is low. Organic matter content is low. Runoff is slow.

In the Boelus soil, permeability is rapid in the upper part of the soil and moderate in the lower part. The available water capacity is high. Organic matter content is moderately low.

Many areas of this complex were dryfarmed and since have been reseeded to cool-season grasses and alfalfa, or allowed to return to native vegetation. These areas, and the other areas of native vegetation, are used for hayland or rangeland. In recent years, some areas are used for cropland under sprinkler irrigation systems.

These soils generally are unsuited to dryfarming due to the hazard of severe soil blowing. Valentine soils also are very droughty.

If sprinkler irrigated, this complex is poorly suited to use as cropland. The soils are unsuited to gravity irrigation systems due to the hummocky topography and very high water intake rate of the Valentine soils. Soil blowing is the most serious hazard. Under sprinkler irrigation, corn, alfalfa, and introduced grasses are suited to these soils. Management of irrigation water and tillage practices are very important in controlling soil blowing. Using cropping systems that keep crops, grass, or crop residue on the soil surface will help control soil blowing and conserve moisture. Returning crop residue to the soil and using barnyard manure will help maintain the organic matter content.

These soils are suited to rangeland, and this use is very effective in controlling soil blowing and water erosion. The natural plant community is mostly tall and mid grasses dominated by sand bluestem, blue grama, little bluestem, prairie sandreed, sand lovegrass, switchgrass, and needleandthread. If the plants are overgrazed or improperly harvested for hay, sand bluestem, little bluestem, switchgrass, and sand lovegrass decrease, and needleandthread, prairie sandreed, blue grama, sand dropseed, and other annual and perennial weeds increase. If overgrazing continues for many years, the less desirable plants increase; and as the protective cover provided by the more desirable plants decreases, sand movement increases and blowouts can develop.

This map unit is suited to planting trees and shrubs in windbreaks; however, only trees and shrubs tolerant of sandy, droughty conditions are suited. Irrigation can provide supplemental water during droughts. Soil blowing can be controlled by maintaining strips of sod or other vegetation between the rows. The Valentine soil is so sandy that trees need to be planted in shallow furrows, with as little disturbance of the soil as possible. Weeds and undesirable grasses in the tree rows can be controlled by using the appropriate herbicides or by hand cultivation.

These soils generally are suited to dwellings with basements and local roads and streets. Care should be taken on the Valentine soil that seepage from septic tank absorption fields does not contaminate nearby water supplies. This soil readily absorbs effluent from septic tank systems, but it does not adequately filter the effluent. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving. On the Boelus soil, foundations for buildings without basements need to be strengthened and backfilled with coarse material to prevent damage caused by the shrinking and swelling of the soil. Also, roads and streets on areas of the Boelus soil need to be designed so that the surface pavement and subbase are thick enough to compensate for the low strength of the soil material. Coarse-grained material can be used for subgrade or base material to ensure better performance. Also, base material can be mixed with additives, such as hydrated lime, to help prevent shrinking and swelling.

These soils are assigned to capability units VIe-5, dryland, and IVe-11, irrigated. The Valentine soil is in the Sands range site and windbreak suitability group 7. The Boelus soil is in the Sandy range site and windbreak suitability group 5.

VfD—Valentine-Els sands, 0 to 9 percent slopes. This complex consists of deep, excessively drained, gently sloping to strongly sloping Valentine fine sand and deep, nearly level, somewhat poorly drained Els fine sand in areas of sandhills. Areas range from 10 to 1,000 acres in size. About 50 to 55 percent of this complex is Valentine fine sand, and 35 to 45 percent is Els fine sand. Valentine fine sand is on the hummocky areas. Els fine sand is in the swales between the hummocky areas

and is rarely flooded. The individual areas of the two soils are so intricately mixed or so small that it is not practical to separate them at the scale used in mapping.

Typically, the Valentine soil has a surface layer that is grayish brown, loose fine sand about 4 inches thick. The next layer is brown, loose fine sand about 4 inches thick. The underlying material is pale brown fine sand to a depth of more than 60 inches.

Typically, the Els soil has a surface layer that is grayish brown, loose fine sand about 6 inches thick. The next layer is mottled, light brownish gray, loose fine sand about 6 inches thick. The underlying material, which is mottled, is very pale brown and light gray fine sand to a depth of more than 60 inches. In a few places, the dark surface layer is more than 10 inches thick. In a few places, gravelly material is below a depth of 20 inches.

Included with these soils in mapping are small areas of Ipage, Loup, Marlake, and Tryon soils. Ipage soils occupy positions on the landscape between the Valentine and Els soils and are moderately well drained. Loup, Marlake, and Tryon soils are lower than the Els soil on the landscape. Marlake soils are very poorly drained. Loup and Tryon soils are poorly drained or very poorly drained. Blowouts are common. The inclusions make up 10 to 15 percent of the unit.

Permeability is rapid in both the Valentine and Els soils. Both soils have low available water capacity. The organic matter content is low in the Valentine soil and moderately low in the Els soil. These soils have a very high water intake rate. Runoff is slow to very slow. The seasonal high water table is below a depth of 6 feet in the Valentine soil. The seasonal high water table in the Els soil ranges from a depth of about 1.5 feet in wet years to about 3.0 feet in dry years.

Most of the acreage of this complex is in native grass used for range or hayland. A small acreage is used for irrigated cropland.

The soils in this complex are unsuited to dryfarming because of droughtiness and the hazard of soil blowing.

Under irrigation, the soils in this complex are poorly suited to corn, alfalfa, and introduced grasses. These soils are unsuitable for gravity irrigation but can be sprinkler irrigated. Wetness caused by the seasonal high water table can be a problem during the wettest seasons, but during dry years subirrigation can benefit crops. Artificial drainage may be needed. Soil blowing is a hazard if the surface is not adequately protected by growing crops or crop residue. Soil blowing can be controlled by using winter cover crops and close-growing crops and leaving crop residue on the surface. Grazing of crop residue by livestock should be limited. Applying barnyard manure increases the organic matter content and improves fertility.

These soils are suited to rangeland, and this use is very effective in controlling soil blowing and water erosion. The natural plant community is mostly tall and mid grasses, grasslike plants, and various sedges. The Valentine soil generally is dominated by sand bluestem, blue grama, little bluestem, prairie sandreed, switchgrass, and needleandthread. The Els soil generally is dominated by big bluestem, little bluestem, indiangrass, switchgrass, and prairie cordgrass. In overgrazed areas of the Valentine soil, Scribner panicum, blue grama, sand dropseed, and numerous annual and perennial weeds may become dominant. In overgrazed areas of the Els soil, the plant cover may be dominated by timothy, redtop, foxtail barley, clover, sedges, and rushes.

The soils in this complex are suited to planting trees and shrubs in windbreaks. The soils are so sandy that trees need to be planted in shallow furrows, with as little disturbance of the soil as possible. Young seedlings may be covered by drifting sand during high winds or be damaged by sand blasting. Strips of sod should be maintained between the tree rows. The species selected for planting on the Els soil must be those that can tolerate occasional wetness. Establishing trees can be a problem in wet seasons. The weeds or undesirable grasses are a problem but can be controlled by cultivating with conventional equipment or by timely use of herbicides. Areas near the trees can be rototilled or hoed by hand.

If the soils are used for septic tank absorption fields, care should be taken to be certain that pollution by seepage does not contaminate the ground water. These soils readily absorb effluent from septic tank systems but do not adequately filter it. Sewage lagoons need to be lined or sealed to prevent seepage. Sewage lagoons on the Els soil need to be constructed on fill material to raise the lagoon above the seasonal high water table. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving. Digging in the Els soil should be done when the soil is not wet for easier operation of machinery and to avoid cave-in and water problems. The Valentine soil generally is suited to dwellings and local roads and streets. In areas of the Valentine soil, dwellings may need to be designed to complement the slope, or the site can be graded. Sites for dwellings and other buildings on Els soil should be elevated with well-compacted fill material because of the seasonal high water table and the flood hazard. If roads and streets are constructed on Els soils, a suitable, well-compacted fill material and adequate side ditches and culverts are needed to protect the roads from flooding and wetness. On Els soil, road damage caused by frost action can be reduced by providing good surface drainage and by the use of a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

These soils are assigned to capability units VIe-5, dryland, and IVe-12, irrigated. The Valentine soil is in the Sands range site and windbreak suitability group 7. The Els soil is in the Subirrigated range site and windbreak suitability group 2S.

VoB—Vetal loam, 1 to 3 percent slopes. This deep, very gently sloping, well drained soil is in upland swales and on alluvial fans. Areas range from 20 to 100 acres in size.

Typically, the surface layer is dark gray, very friable loam about 6 inches thick. The subsurface layer is very friable loam about 16 inches thick. It is dark gray in the upper part and dark grayish brown in the lower part. The next layer is dark grayish brown, very friable sandy loam in the upper part and grayish brown, loose loamy sand in the lower part. It is about 20 inches thick. The underlying material is light gray sand to a depth of more than 60 inches. In some places, the dark surface layer is less than 20 inches thick.

Included with this soil in mapping are small areas of Ord, Pivot, and Wewela soils. Ord soils are somewhat poorly drained and are lower on the landscape. Pivot soils are moderately deep to coarse sand or gravelly coarse sand and have a dark surface layer less than 20 inches thick. They are in positions on the landscape similar to those of the Vetal soils. Wewela soils are lower on the landscape than the Vetal soils. They are moderately deep to shale. Included soils make up 10 to 15 percent of the unit.

In this Vetal soil, permeability is moderately rapid. The available water capacity is moderate. Organic matter content is moderate. Runoff is slow to medium. The water intake rate is moderate.

Most of the acreage of this soil is cropland. The remaining acreage is in native grass used for rangeland. A large acreage of the cropland is irrigated.

If dryfarmed, this soil is suited to corn, grain and forage sorghum, small grains, alfalfa, and introduced grasses. Soil blowing is the main hazard if the surface is not adequately protected by growing crops or crop residue. Conservation tillage practices, such as disking and chiseling, can be used to keep all or part of the crop residue on the soil surface to help prevent soil blowing and conserve soil moisture. This soil is droughty because of its moderate available water capacity. Returning crop residue to the soil helps maintain the organic matter content and soil fertility.

If irrigated, this soil is suited to corn, sorghum, alfalfa, and introduced grasses. Sprinkler and gravity irrigation systems are suitable for this soil. For gravity irrigation systems, some land grading generally is needed. Light, frequent applications of irrigation water are needed. Soil blowing is a serious hazard. Soil blowing can be reduced and soil moisture conserved by stubble-mulch tillage and use of cropping systems that keep the soil covered with crops or crop residue most of the time. Adding barnyard manure to the soil increases the organic matter content and improves natural fertility and the water intake rate.

This soil is suited to rangeland, and this use is very effective in controlling soil blowing and water erosion. The natural plant community is mostly tall and mid grasses dominated by big bluestem, little bluestem, sideoats grama, switchgrass, and western wheatgrass. If these plants are overgrazed, big and little bluestem and switchgrass decrease, and sideoats grama, western wheatgrass, and blue grama increase.

This soil generally provides a good site for planting trees and shrubs in windbreaks and plantings for recreation and wildlife. Survival of adapted species is good. Moisture competition from grass and weeds can be controlled by good site preparation and timely cultivation and use of herbicides.

This soil generally is suited to use as a site for dwellings. This soil readily absorbs the effluent from septic tank systems, but it does not adequately filter the effluent. The poor filtering capacity may result in pollution of the ground water. Sewage lagoons need to be lined or sealed to prevent seepage. Damage to roads and streets by frost action can be reduced by providing good surface drainage. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is assigned to capability units IIe-1, dryland, and IIe-6, irrigated, the Silty range site, and windbreak suitability group 5.

WeC—Wewela fine sandy loam, 2 to 6 percent slopes. This gently sloping, well drained soil is on uplands. It is moderately deep over shale. Areas range from 20 to 100 acres in size.

Typically, the surface layer is dark grayish brown, very friable fine sandy loam about 7 inches thick. The subsoil, about 17 inches thick, is dark grayish brown, very friable sandy clay loam in the upper part; yellowish brown, friable sandy clay loam in the middle part; and light yellowish brown, firm clay in the lower part. The underlying material, about 12 inches thick, is light yellowish brown shaly clay. Light yellowish brown, bedded shale is at a depth of about 36 inches. In places, the surface layer is sandy clay loam or fine sand. In some places, the bedded shale is below a depth of 40 inches.

Included with this soil in mapping are small areas of Brunswick, Valentine, and Vetal soils. Brunswick, Valentine, and Vetal soils do not have shale within a depth of 40 inches. Brunswick, Valentine, and Vetal soils occur on higher positions on the landscape. Valentine soils do not have a darker surface layer and are sandy to a depth of more than 40 inches. Vetal soils have a dark surface layer that extends to a depth of more than 20 inches. Included soils make up 10 to 15 percent of the unit.

In this Wewela soil, permeability is moderate in the loamy upper part and slow in the clayey lower part. The available water capacity is low. Organic matter content is moderately low. Runoff is slow. The water intake rate is moderately high. Because of the clayey subsoil and clayey shale underlying material, the soil releases water slowly to plants. Tilth generally is good, and the soil is

easily tilled, except in eroded areas where the clayey material is at the surface. In these areas, tilth is poor and the soil is difficult to work.

About half the acreage of this soil is in cultivated cropland, and the rest is in native grass used for rangeland.

If dryfarmed, this soil is poorly suited to corn, grain and forage sorghum, alfalfa, and introduced grasses. Alfalfa and introduced grasses are best suited. Soil blowing and water erosion are the main hazards on this soil. Use of terraces, contour farming, and stripcropping and establishing grassed waterways help to control water erosion. A cropping system that includes legumes or a mixture of grasses and legumes helps to replenish the supply of organic matter, maintain fertility, and control soil blowing. Tillage operations that leave all or most of the crop residue on the surface conserve soil moisture, improve the organic matter content, and help to control soil blowing. Adding barnyard manure increases fertility.

If irrigated, this soil is suited to corn, grain and forage sorghum, and alfalfa. Tillage operations that leave crop residue at the surface reduce soil erosion and improve the water intake rate. Growing grasses and legumes in the cropping system increases the organic matter content.

This soil is suited to rangeland, and this use is very effective in controlling soil blowing and water erosion. The natural plant community is dominated by sand bluestem, little bluestem, prairie sandreed, switchgrass, and needleandthread. In overgrazed areas, the site may be dominated by sand dropseed, Scribner panicum, blue grama, and numerous annual and perennial weeds.

This soil is poorly suited to trees and shrubs planted in windbreaks. Erosion and insufficient seasonal rainfall are problems. Irrigation can provide supplemental water during periods of insufficient moisture. Trees can be planted on the contour to save moisture and help prevent runoff and erosion. Competition for moisture from grasses and weeds can be a problem. Cultivation with conventional equipment can be used to control undesirable grasses and weeds. Areas in the row can be treated with appropriate herbicides. Some areas may need to be rototilled or hoed by hand.

This soil is not suitable for septic tank absorption fields because of slow permeability. A suitable alternate site is needed. Sewage lagoons can be constructed on areas of this soil if, after excavation, the bottom of the lagoon is sealed to prevent seepage. Digging in this soil should be done when the soil is moist but not wet. Foundations for buildings need to be strengthened and backfilled with coarse material to prevent damage by the shrinking and swelling of the soil. Roads and streets should be designed so that the surface pavement and subbase are thick enough to compensate for the low strength of the soil material. Coarse-grained material can be used for subgrade or base material to ensure better performance. The base material for roads and streets can be mixed with additives, such as hydrated lime, to help prevent shrinking and swelling.

This soil is assigned to capability units IVe-3, dryland, and IVe-9, irrigated, the Sandy range site, and windbreak suitability group 4C.

Prime Farmland

Prime farmland is one of several kinds of important farmlands defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. The supply of high quality farmland is limited and the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, must encourage and facilitate the use of our Nation's prime farmland with wisdom and foresight.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to producing food, feed, forage, fiber, and oilseed crops. It has the soil quality, growing season, and moisture supply needed to economically produce a sustained high yield of crops when it is treated and managed using acceptable farming methods. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland may now be in crops, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It must either be used for producing food or fiber or be available for these uses.

Prime farmland usually has an adequate and dependable supply of moisture from precipitation or irrigation. It also has favorable temperature and growing season, acceptable acidity or alkalinity. It has few or no rocks and is permeable to water and air. Prime farmland is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. For more detailed information on the criteria for prime farmland, consult the local staff of the Soil Conservation Service.

About 1,700 acres or nearly 0.3 percent of Rock County meets the soil requirements for prime farmland.

A recent trend in land use in some parts of the county has been the loss of some prime farmlands to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and difficult to cultivate and usually less productive.

The soil map units that make up prime farmland in Rock County are listed in this section. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps in the back of this publication. The soil qualities that affect use and management are described in the section "Detailed Soil Map Units."

Soils that have limitations—a high water table, flooding, or inadequate rainfall—may qualify for prime farmland if these limitations are overcome by such measures as drainage, flood control, or irrigation. In the following list the measures used to overcome the limitations, if any, are shown in parentheses after the map unit name. On-site evaluation is necessary to see if these limitations have been overcome by corrective measures.

The map units that meet the soil requirements for prime farmland are:

Or Ord loam, 0 to 2 percent slopes (where drained)
VoB Vetal loam, 1 to 3 percent slopes

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and windbreaks; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

Prepared by William E. Reinsch, conservation agronomist, Soil Conservation Service.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

Most of the farmland in Rock County used for cultivated crops is irrigated. According to the 1978 Nebraska Agriculture Census, 27 percent of the acreage in farms is used as cropland (*12*). The largest acreage is in corn, and over 75 percent of the irrigated cropland in the county is in corn.

Dryland Management

Good management practices on soils are those that reduce runoff, reduce the risk of erosion, conserve moisture, and improve tilth. Many of the soils in Rock County are suited to crop production. However, the hazard of soil blowing is severe, and conservation practices are needed.

Conservation tillage systems that keep crop residue on the surface help to reduce water erosion, increase rates of water intake, reduce water runoff, increase the amount of moisture for crops, and reduce soil blowing. Keeping crop residue or plant cover on the surface reduces puddling of the soil during and after heavy rains. In winter, standing stubble catches drifting snow that can provide additional moisture.

Soil blowing in Rock County is a major hazard. Practices that control soil blowing are crop residue management, the use of conservation tillage practices, contour stripcropping, and the planting of narrow field windbreaks. The overall hazard of erosion can be reduced if areas of the more productive soils are used for row crops and the more sandy, more erosive soils are used for close grown crops, such as small grains, alfalfa, or grasses for hay and pasture. Proper use of the land alone can reduce the hazard of erosion.

In Rock County, insufficient rainfall commonly is a limiting factor in crop production. A cropping system and management practices that control erosion need to be planned to fit the soils in each field.

The sequence of crops grown on a field in combination with the practices used for the management and conservation of the soil is known as a resource

management system. Under dryland farming, the management practices and cropping sequence should preserve tilth and fertility, maintain a plant cover that protects the soil from erosion, and control weeds, insects, and diseases. Cropland resource management systems vary according to the soils on which they are used. For example, a resource management system for cultivated fields on Valentine loamy fine sand, 3 to 9 percent slopes, should allow crop residue to remain standing on the soil over winter. In addition, the resource management system would specify the use of a conservation tillage system that leaves 50 to 75 percent of the soil covered by crop residue after planting the crop.

At the time of planting, the soils need to be worked to prepare a seedbed, control weeds, and provide a favorable place for plants to grow. Excessive tillage, however, reduces the residue cover and allows the soil to blow. Keeping tillage at a minimum is required to manage most Rock County soils. Various conservation tillage practices can be used in Rock County. The no-till, till-plant, and disc-and-plant or chisel-and-plant systems are practices well suited to row crops. Grasses can be established by drilling into a cover of stubble without further seedbed preparation.

All soils that are used for cultivated crops or for pasture should be tested to determine their need for additional nutrients. Under dryland farming, the kind and amount of fertilizer to be applied should be based on the results of soil tests and on the moisture content of the soil at the time when fertilizer is applied. If the subsoil is dry or rainfall is below normal, the amount of nitrogen fertilizer applied should be slightly less than the recommended amount.

Nitrogen fertilizer benefits nonlegume crops on all soils. Phosphorus and zinc are needed on the more eroded soils. Dryland soils require smaller amounts of fertilizer than do irrigated soils because the plant population is generally lower.

Some soils in Rock County are somewhat poorly drained because of a moderately high water table. Open drainage ditches and underground tile systems can be used to help lower the water table if suitable outlets at low elevations can be located. Where the water table cannot be lowered sufficiently for good crop growth, crops that tolerate wet conditions can be planted.

Herbicides can be used to control weeds. Care needs to be taken to apply the correct kind of herbicide at the proper rate to correspond with the soil conditions. The humus, or organic, fraction of the soil is responsible for the greatest part of the chemical activity of the soil. Therefore, crop damage from herbicides is more likely to occur on the coarse and moderately coarse soils that are low in organic matter. Herbicides need to be applied at a correspondingly lower rate on these soils and in accordance with instructions on the label.

Irrigation Management

Acording to the Nebraska Agricultural Statistics, in 1980, more than 83 percent of all row crops in Rock County were grown under irrigation. More than 75 percent of the irrigated cropland was used for corn, and a small acreage was in alfalfa.

Both the furrow and sprinkler systems can be used to irrigate corn and other row crops.

Mostly row crops are grown on soils that are well suited to irrigation. Changing from corn to alfalfa and grass helps to control the plant diseases and insects that are common if the same crop is grown year after year. In Rock County, Dunday and Pivot loamy sands and Valentine fine sand, if used for cultivated cropland, are very vulnerable to soil blowing. Where irrigation is used on these soils, soil blowing can be controlled by leaving a minimum of 3,500 pounds of standing corn stalks 16 inches tall until the spring crop is planted. Conservation practices, such as conservation tillage, use of crop residue, and contour farming where needed, help to conserve the supply of irrigation water by reducing evaporation, increasing intake of rainfall, reducing runoff, and controlling water erosion and soil blowing.

If the sprinkler irrigation method is used, water should be applied at a rate that allows the soil to absorb the water and does not produce runoff. Sprinklers can be used on the hummocky and sloping soils as well as on the nearly level ones. Coarse textured soils, such as Valentine loamy fine sand, 3 to 9 percent slopes, are suited to sprinkler irrigation when conservation practices are applied that protect the soil from blowing. In summer, much water is lost through evaporation and because of wind drift. Strong winds cause uneven application of water by sprinkler irrigation systems. Watering at night, when temperatures are lower and wind velocities are generally lowest, reduces evaporation and improves distribution.

There are three general kinds of sprinkler systems. One kind is placed at a location, left there until a specified amount of water is applied, and then moved. Another kind revolves on a central pivot. A third kind, called a volume gun, is a single, large sprinkler that applies water while being continually moved.

Because soil holds a limited amount of water, irrigation water or precipitation is needed at regular intervals to keep the soil moist. The application interval varies according to the crop, the soil, and the amount of moisture in the soil. The water should be applied no faster than the soil can absorb it.

Irrigated sandy soils in Rock County hold about 1 inch of available water per foot of soil depth. A soil that is 4 feet deep and planted to a crop that sends its roots to a depth of 4 feet supplies about 4 inches of available water for the crop.

For maximum efficiency, irrigation should be started when about one-half of the stored water has been used

by the plants. If a soil holds 4 inches of available water, irrigation should be started when about 2 inches have been removed by the crop. An irrigation system should be planned to replace water at the rate that will provide a stable water supply for the crop.

Irrigated soils produce higher yields than do dryfarmed soils. Consequently, more plant nutrients, particularly nitrogen and phosphorus, are removed in harvested crops. Returning all crop residue to the soil and adding feedlot manure and commercial fertilizer help to maintain the needed plant nutrients.

Most grain crops in Rock County respond to nitrogen fertilizer. Soils disturbed during land leveling, particularly if the topsoil has been removed, respond to phosphorus, zinc, and iron. The kinds and amounts of fertilizer needed for specific crops should be determined by soil tests.

The soils in Rock County that are suited to irrigation are assigned to an irrigation design group. These design groups are described in the Irrigation Guide for Nebraska (*8*), which is part of the technical specifications for conservation in Nebraska. The arabic numbers in the capability classification for irrigated soil indicate the design group to which a soil belongs.

Assistance in planning and designing an irrigation system is available through the local office of the Soil Conservation Service or the county agricultural agent.

Pasture and Hayland Management

Areas that are in hay or pasture should be managed for maximum production. Once the pasture is established, the grasses need to be kept productive. A planned system of grazing that meets the needs of the plants and promotes uniform utilization of forage is important if high returns are expected. Most forage plants are a good source of minerals, vitamins, proteins, and other nutrients. A well managed pasture can provide a balanced ration throughout the growing season.

A mixture of grasses and legumes can be grown on many kinds of soils, and if properly managed the soil can return a fair profit. Grasses and legumes are compatible with grain crops in a crop rotation and have beneficial effects on soil building. Because grasses and legumes add organic matter and reduce erosion, they are an ideal crop for use in a conservation cropping system.

Grasses and legumes that are used for pasture and hayland, either irrigated or nonirrigated, require additional plant nutrients to obtain maximum vigor and growth. The kinds and amounts of fertilizer needed should be determined by a soil test. The most commonly grown grasses for irrigated pastures are smooth brome and orchardgrass. Other grasses that are suited to irrigation in Rock County are intermediate wheatgrass, meadow brome, and creeping foxtail. Legumes that have potential for irrigated or nonirrigated pastures are alfalfa, birdsfoot trefoil, and cicer milkvetch.

Irrigated pastures in Rock County on soils such as Vetal loam, 1 to 3 percent slopes, can produce 500 to 800 pounds of beef per acre under a high level of management. Irrigated pastures are an economic alternative in choosing a resource management system for irrigated croplands. Cropland can be converted to irrigated pastureland to control erosion.

Grasses that have potential for use as pasture without irrigation on such soils as Dunday loamy fine sand, 0 to 3 percent slopes, are smooth brome, intermediate wheatgrass, and orchardgrass. Some native warm-season grasses, if planted as a single species on nonirrigated land, are compatible with cool-season pastures to extend forage quality during the grazing season. Switchgrass, indiangrass, and big bluestem are native warm-season grasss that can be used in a planned system of grazing to provide high quality forage for grazing animals during the summer months.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information

about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w,* or *s,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); and *s* shows that the soil is limited mainly because it is shallow, droughty, or stony.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w* or *s* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-5 or IIIe-6.

The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in table 5.

Rangeland

Prepared by Peter N. Jensen, range conservationist, Soil Conservation Service.

Rangeland amounts to approximately 85 percent of the total agricultural land in Rock County. Although rangeland is scattered throughout the county, the greatest concentration is in the Nebraska Sandhills in the southern area. The soil associations used mainly for grazing or native hay are Els-Valentine-Tryon, Loup-Elsmere, and Valentine, which are described under the heading "General Soil Map Units." The Valentine-Dunday soil association is also used principally for rangeland, although there has been some use of center-pivot irrigation for corn or alfalfa for hay production. The average size of ranches in Rock County is about 4,000 acres.

Livestock raising, mainly cow and calf herds, is the largest agricultural industry in the county. Calves are sold in the fall as feeders. From late spring to early fall, livestock generally graze the range. In the fall, they graze the regrowth of native meadows or feed on corn residue from irrigated cropland. During the winter and early spring, livestock are fed native hay or alfalfa hay or a combination of both. The forage from rangeland is supplemented by protein in the fall and winter months.

The main objective of range management is to maintain the range in good or excellent condition. Some of the rangeland in Rock County has been overgrazed (fig. 13). Approximately 35 percent of the rangeland produces less than half of its potential in kind or amount of native plants, mainly because of livestock overuse caused by overstocking and poor livestock distribution.

Range management practices that maintain or improve range condition are economical and are needed on all rangeland that is grazed. These practices include proper grazing use that leaves adequate plant cover to maintain or improve plant vigor, deferrment of grazing or allowing key management plants to rest periodically during the stage of carbohydrate storage, and establishment of a planned grazing system whereby the pastures are alternately grazed and rested in a planned sequence. Also, livestock can be distributed better and more uniform grazing can be obtained in a pasture by properly

Figure 13.—The rangeland on the right of the fence has been overgrazed. Tall grasses have been nearly eliminated and yields reduced, and short grasses and invading annuals produce most of the forage. The soils are Valentine fine sand, 3 to 9 percent slopes, and Valentine fine sand, rolling.

locating fences, by developing livestock watering facilities, such as wells and stockponds, and by moving salt to areas where grazing is desired.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils, vegetation, and availability of water.

On certain Sandy and Sands range sites, the production on abandoned cropland (dryland or irrigated) can be improved by planting the area to a mixture of suitable native grasses. After the range has been established, production can be maintained by proper grazing or haying management practices. Unstabilized sandy blowouts may need to be enclosed with a fence and shaped, seeded, and mulched to protect adjacent grasses from sandy blowing or deposition.

Native meadows make up a significant percentage of the rangeland in Rock County and are used for the production of native hay. The rangeland is generally

used for meadow where the water table is high in the Wet Land, Wet Subirrigated, Subirrigated, and Saline Subirrigated sites. The dominant vegetation is big bluestem, little bluestem, indiangrass, switchgrass, prairie cordgrass, reedgrasses, and various members of the sedge family. Mowing has reduced the large population of native wildflowers.

Production from native meadows can be maintained or improved by proper management. The best time to mow is before the grass flowers. Maximum storage of carbohydrates occurs when the seed is mature, which coincides with the frost period for the dominant grasses. Mowing to proper heights is important in maintaining the stand of grasses and a high forage production. Mowing closer than 3 inches reduces plant vigor.

Meadows should not be grazed when the soil is wet or when the water table is within a depth of 6 inches. Grazing when the soil is wet causes the formation of small bogs or mounds, and these cause difficulty in mowing during subsequent years. Meadows can be grazed after the hay has been harvested and frost has appeared.

Table 6 shows, for almost every soil, the range site and the potential annual production of vegetation in favorable, normal, and unfavorable years. Only those soils that are used as rangeland or are suited to rangeland are listed. Explanation of the column headings in table 6 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Potential annual production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the prevailing temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture. Dry weight is the total annual yield per acre reduced to a common percent of air-dry moisture.

Most of the rangeland in Rock County is in the Wet Subirrigated, Subirrigated, Sandy, Sands, and Choppy Sands range sites. The remaining areas are in the Wet Land, Saline Subirrigated, Sandy Lowland, Clayey, Savannah, Shallow Limy, Shallow Clay, and Shallow to Gravel range sites.

At the end of each map unit description, the soil or soils in that unit are placed in an appropriate range site according to the kind and amount of vegetation that is grown on the soil when the site is in climax or natural potential condition. The description and interpretations for each range site in the county are in the Technical Guide, which is in the local office of the Soil Conservation Service. Ranchers or livestock producers who want technical assistance with reseeding cropland, developing a planned grazing system, or with other range management or improvement conservation practices can obtain help from the local office of the Soil Conservation Service.

Native Woodland

Prepared by Keith A. Ticknor, forester, Soil Conservation Service.

Approximately 8,200 acres, or 1.3 percent of Rock County, is forested. This woodland occurs on the side slopes and on the breaks that lead to the Niobrara River Valley. Much of the river valley adjacent to the river is also wooded. In addition, numerous timber claim plantings can be found throughout the county. These plantings are in blocks and occur on the uplands and bottom lands where a water table is within reach of the tree roots.

Trees on the side slopes of the Niobrara River Valley are mostly bur oak, but other species, such as eastern redcedar, green ash, boxelder, American elm, western snowberry, smooth sumac, and silver buffaloberry also occur in the stand. On the breaks to the river, trees are found mostly in the major drainageways. Eastern cottonwood, green ash, boxelder, and white poplar are some of the major species in these areas.

Wooded areas along the river consist mostly of eastern cottonwood, black willow, green ash, boxelder, eastern redcedar, American basswood, and black walnut.

Timber claims were planted mostly as pure stands of eastern cottonwood. Other species associated with these plantings are Siberian elm, boxelder, eastern redcedar, black willow, Russian-olive, and green ash. Some of these species were planted with the timber claims, but most are volunteers.

Many of the trees, especially black walnut, green ash, eastern cottonwood, and bur oak, have commercial value for wood products; however, very few wooded areas are managed for commercial production. Most of the wooded areas are in private ownership and make up only a small acreage of the farm or ranch unit.

Since 1955, the woodland acreage in Rock County has declined approximately 13 percent. Most of this decline has occurred as the result of clearing woodland and converting it to cropland (*12*).

Bottom land soils along the river and in drainageways have potential for production of sawtimber, firewood, Christmas trees, and other wood products. Odd areas or small, irregular fields are good sites for wood production.

Windbreaks and Environmental Plantings

Prepared by Keith A. Ticknor, forester, Soil Conservation Service.

Around most ranch headquarters and farmsteads in Rock County are trees that have been planted at various times by the landowners. Many of the headquarters and farmsteads are in or adjacent to the timber claim plantings. In addition, there are numerous livestock protection windbreaks in the county. Eastern cottonwood and Siberian elm are the most common trees at ranch headquarters. Other common tree and shrub species include eastern redcedar, ponderosa pine, lilac, green ash, black locust, jack pine, American plum, boxelder, and northern catalpa.

Tree planting around the farmstead or ranch headquarters is a continuing process. Old trees pass maturity and deteriorate, some trees are lost to insect and disease attacks, others are destroyed by storms, and new windbreaks are needed for expanding operations. Most new plantings around the headquarters consist of eastern redcedar and ponderosa pine, Austrian pine, or Scotch pine. New livestock protection plantings are being made using eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and American plum.

Field windbreaks or shelterbelts are scattered throughout the county. Many new plantings are now being made in some of the field corners of center-pivot irrigated fields. These trees have replaced some of the trees that were removed for center-pivot installation.

In order for windbreaks to fulfill the intended purpose, the species of trees or shrubs selected must be suited to the soils in the area to be planted. Matching the proper trees with the soil type is the first step toward ensuring survival of the seedlings and maximum growth of the trees. Permeability, available water capacity, fertility, soil texture, soil depth, and drainage are soil characteristics that greatly affect the rate of growth of trees and shrubs in windbreaks.

Trees and shrubs are somewhat difficult to establish in Rock County because of dry conditions and competition from other vegetation. Proper site preparation before planting and controlling weed and grass competition after planting are important concerns in establishing and managing windbreaks. Supplemental watering may be needed during establishment.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

Prepared by Robert O. Koerner, biologist, Soil Conservation Service.

Twelve kinds of recreation activities were evaluated and appraised by representatives of county, state, and federal agencies, as well as local private organizations (*11*). Rated as having high potential were vacation cabins, cottages, and homesites; camping areas; and vacation farms and ranches. Those rated as having medium potential were fishing waters; hunting areas; and natural, scenic, and historic areas. Those rated as having low potential were picnic and sports areas, golf courses, riding stables, and shooting preserves. Water sports areas and winter sports areas were not rated.

A number of vacation areas have been developed in Rock County. The Bassett Municipal Golf Course offers picnicking as well as golfing. The Rock County fairgrounds in the city of Bassett offer picnicking, swimming, playgrounds, and overnight camping. A private roadside park at Newport provides picnicking, a play area, overnight camping, and nature study (*11*).

Fishing is available in the Niobrara River, as well as in private ponds and lakes throughout the county. Hunting for antelope, deer, wild turkey, grouse, pheasant, quail, and mourning dove during the regular established seasons is possible with permission from the landowners. Waterfowl hunting is possible along the Niobrara River and in the wetland areas of the county.

Technical assistance is available for improving wildlife habitat and for designing recreation facilities in Rock County. The Soil Conservation Service's field office in Ainsworth can either provide this assistance or suggest an agency that can provide assistance.

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Prepared by Robert O. Koerner, biologist, Soil Conservation Service.

Wildlife habitat depends on the soil, topography, slope, and drainage pattern of a particular area. Rock County offers a wide variety of habitat types for openland, wetland, woodland, and rangeland species of wildlife.

The wooded drainages and bottom lands along the Niobrara River and the adjacent upland cropland make ideal range for wild turkey, whitetail deer, muledeer, bobwhite quail, tree squirrel, fox, coyote, cottontail rabbit, raccoon, opossum, and ring-necked pheasant.

Other species found during migration periods include waterfowl, shore birds, songbirds, hawks, owls, and eagles.

Vegetation plays a major role in the quality and diversity of wildlife habitat. Tree, shrub, and vine species found adjacent to and in the drainageways flowing into the Niobrara include bur oak, boxelder, green ash, hackberry, eastern redcedar, cottonwood, willow, American linden, elm, American plum, chokecherry, coralberry, silver buffaloberry, ponderosa pine, Russian-olive, mulberry, black walnut, wild grape, woodbine, Virginia creeper, and poison ivy.

Wild turkeys have been increasing in numbers and distribution throughout the county. Although they are mainly along the Niobrara River, flocks of turkeys have also been observed throughout the county in areas where woodland is in blocks. Sandy soils predominate in areas of the county that are not near the Niobrara River. Irrigation is common where water supplies are available. This combination of cropland interspersed with large areas of native rangeland provides habitat for rangeland and openland wildlife species, such as prairie grouse, deer, antelope, fox, coyote, and badger. Mourning dove is found throughout the county.

In low areas where the water table is near the surface, large cottonwood groves can be found. These areas do not provide a great deal of cover, but they do provide den trees for raccoons and woodpeckers and perches for predatory hawks, owls, and eagles.

Farmstead windbreaks and field shelterbelts provide food and cover for wildlife and are found throughout the county. Plum and chokecherry thickets are found along roadsides and fence lines. These provide food and escape cover for quail, rabbit, and pheasant.

Corners of fields irrigated by center-pivot systems provide opportunities for developing wildlife habitat in the form of nesting and escape cover. In these areas, the irrigation systems provide water, regardless of rainfall patterns.

Throughout the county are wetlands where the water table is at or near the surface, forming natural shallow lakes. Waterfowl, shore birds, muskrat, mink, pheasant, and deer use these areas for cover, food, and water.

Delaying mowing of the hay meadows until July 15 or later increases nesting potential for upland game birds.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, and rye.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are intermediate wheatgrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are big and little bluestem, goldenrod, beggarweed, western wheatgrass, and blue grama.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are green ash, hackberry, bur oak, honeylocust, Siberian elm, and eastern cottonwood. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, American plum, and common chokecherry.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are ponderosa pine, eastern redcedar, and jack pine.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are Siberian peashrub, cotoneaster, and skunkbush sumac.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, reed canarygrass, prairie cordgrass, rushes, sedges, and reedgrasses.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are

created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, ring-necked pheasant, meadowlark, field sparrow, cottontail rabbit, and skunk.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, bobwhite quail, thrushes, woodpeckers, squirrels, gray fox, raccoon, deer, and songbirds.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include antelope, deer, prairie grouse, meadowlark, and lark bunting.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 11 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the

ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific

purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design

and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 17.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 14). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

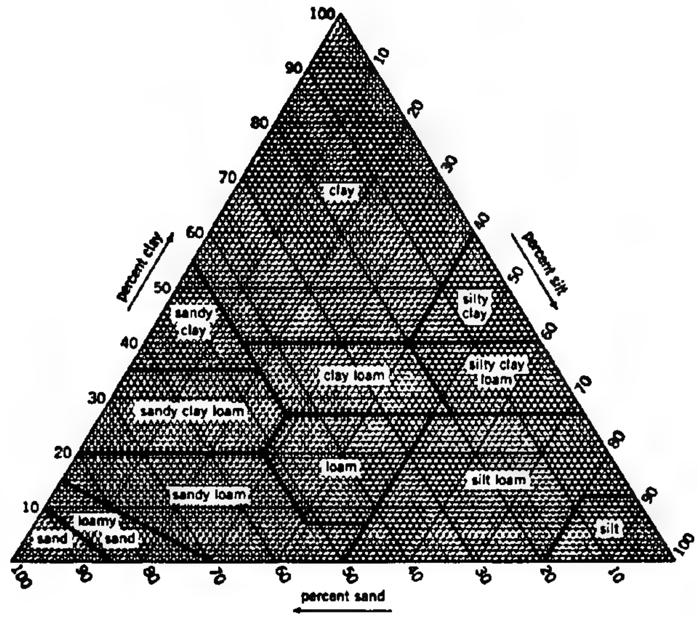

Figure 14.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content

of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 17.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

Physical and Chemical Properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in

place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 15, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is perched, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Physical and Chemical Analyses of Selected Soils

Samples from soil profiles were collected for physical and chemical analysis by the National Soil Survey Laboratory, Soil Conservation Service, in Lincoln, Nebraska. Soils of the Els, Elsmere, Ipage, Loup, Pivot, Tryon, and Valentine series were sampled in Rock County. Soils of the Labu, Sansarc, and Dunday series were sampled in adjoining counties. The data are available at the National Soil Survey Laboratory.

This information is useful to soil scientists in classifying soils and developing concepts of soil genesis. It is helpful in estimating available water capacity, susceptibility to soil blowing, fertility, tilth, and other aspects of soil management.

Engineering Index Test Data

Table 17 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series described in the section "Soil Series and Their Morphology." The soil samples were tested by the Nebraska Department of Roads.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and Specific gravity—T 100 (AASHTO).

The group index number that is part of the AASHTO classification is computed by using the Nebraska modified system.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*10*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustoll (*Ust*, meaning intermittently dry, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplustolls (*Hapl*, meaning minimal horizonation, plus *ustoll*, the suborder of the Mollisols that have a Ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haplustolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is coarse-loamy over sandy or sandy-skeletal, mixed, mesic Typic Haplustolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*8*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*10*). Unless otherwise stated, matrix colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Barney Series

The Barney series consists of poorly drained soils that are on bottom lands along major drainageways. These soils formed in stratified loamy and sandy alluvium. Permeability is moderately rapid in the upper part of the soil and rapid in the lower part. Slopes range from 0 to 2 percent.

Barney soils are adjacent to Boel, Labu, and Valentine soils. Boel and Valentine soils do not have coarse sand within a depth of 40 inches. Boel soils are somewhat poorly drained and are higher on the landscape. Labu soils are clayey throughout and are on higher, well

drained upland positions. Valentine soils are on upland side slopes and are excessively drained.

Typical pedon of Barney fine sandy loam, in an area of Barney-Boel complex, channeled, 1,700 feet north and 800 feet east of the southwest corner of sec. 19, T. 32 N., R. 18 W.

A—0 to 7 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark gray (10YR 3/1) moist; weak fine granular structure; slightly hard, friable; few thin strata of finer and coarser textures; common medium and fine roots; slight effervescence; neutral; abrupt smooth boundary.

C—7 to 12 inches; very pale brown (10YR 7/3) sand, light brownish gray (10YR 6/2) moist; many medium and fine distinct dark brown (7.5YR 4/4 moist) mottles; single grain; loose; common medium and fine roots; neutral; abrupt smooth boundary.

Cg1—12 to 17 inches; light brownish gray (2.5Y 6/2) sandy loam, grayish brown (2.5Y 5/2) moist; few fine distinct dark yellowish brown (10YR 4/4 moist) mottles; single grain; soft, very friable; common medium and fine roots; few fine and medium strata of grayish brown (2.5Y 5/2) fine sand and loamy fine sand; neutral; abrupt smooth boundary.

2Cg2—17 to 60 inches; light gray (2.5Y 7/2) coarse sand, light brownish gray (2.5Y 6/2) moist; common medium and fine prominent strong brown (7.5YR 4/6 moist) mottles; single grain; loose; few medium and fine roots; neutral.

Thickness of the solum and depth of the mollic colors range from 7 to 10 inches. Depth to the 2C horizon ranges from 7 to 20 inches. Depth to carbonates ranges from 0 to 10 inches, but some pedons do not have free carbonates.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. The texture dominantly is fine sandy loam, but the range includes loam, silty clay loam, sandy loam, and loamy fine sand that is finely stratified with coarser textures. The A horizon ranges from neutral to moderately alkaline. The Cg horizon has hue of 10YR and 2.5Y, value of 5 through 7 (4 through 6 moist), and chroma of 1 through 3. It commonly is sand, but the range includes coarse sand, loamy sand, sandy loam, or fine sand that is finely stratified with finer and coarser textures. Faint to prominent brownish and grayish mottles are in this horizon. The Cg horizon is neutral through moderately alkaline. The 2Cg horizon has hue of 2.5Y and 10YR, value of 6 through 8 (5 through 7 moist), and chroma of 1 or 2. It is dominantly coarse sand or sand and less commonly fine sand containing 0 to 15 percent gravel by volume. This horizon is neutral or mildly alkaline and has similar mottling to that of the C horizon.

Boel Series

The Boel series consists of deep, somewhat poorly drained, rapidly permeable soils that formed in loamy and sandy alluvium on bottom lands. Slopes range from 0 to 2 percent.

Boel soils commonly are near Barney, Ipage, Labu, and Valentine soils. Barney soils are poorly drained and are slightly lower on the landscape. Ipage soils are on slightly higher positions than Boel soils. They are less stratified and are moderately well drained. Labu soils are clayey throughout, are on higher positions, and are well drained. Valentine soils are on higher landscape positions and are excessively drained.

Typical pedon of Boel loamy fine sand, 0 to 2 percent slopes, 300 feet west and 50 feet south of the northeast corner of sec. 34, T. 32 N., R. 20 W.

Ap—0 to 8 inches; gray (10YR 5/1) loamy fine sand, very dark gray (10YR 3/1) moist; weak fine granular structure; slightly hard, very friable; common medium and fine roots; mildly alkaline; abrupt smooth boundary.

A—8 to 11 inches; dark gray (10YR 4/1) loamy sand, black (10YR 2/1) moist; weak fine granular structure; slightly hard, very friable; common fine and medium roots; moderately alkaline; clear smooth boundary.

AC—11 to 18 inches; gray (10YR 5/1) loamy sand, very dark grayish brown (10YR 3/2) moist; single grain; soft, loose; few fine and medium roots; neutral; clear wavy boundary.

C1—18 to 38 inches; pale brown (10YR 6/3) sand, brown (10YR 5/3) moist; many fine and coarse faint yellowish brown (10YR 5/4 moist) and many coarse prominent strong brown (7.5YR 4/6 moist) mottles; single grain; soft, loose; moderately alkaline; abrupt wavy boundary.

C2—38 to 46 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; many common prominent strong brown (7.5YR 4/6 moist) mottles; massive; hard, very friable; few fine soft masses of calcium carbonate; strong effervescence; mildly alkaline; abrupt wavy boundary.

C3—46 to 60 inches; light gray (10YR 7/2) coarse sand, light brownish gray (10YR 6/2) moist; many common prominent strong brown (7.5YR 4/6 moist) mottles; single grain; soft, loose; moderately alkaline.

The mollic epipedon and solum range from 10 to 20 inches in thickness. Reaction is neutral to moderately alkaline throughout.

The A horizon has value of 3 through 5 (2 or 3 moist) and chroma of 1 or 2. It is loamy fine sand, loamy sand, sandy loam, or fine sandy loam. The color and texture of

the AC horizon range between those of the A and C horizons. The C horizon is coarse sand or sand with hue of 2.5Y or 10YR, value of 6 through 8 (4 through 7 moist), and chroma of 2 or 3. The C horizon has brownish, reddish, or yellowish mottles. It typically is stratified with layers of lighter and darker material, which may also contain gravel and coarser or finer textured material.

Boelus Series

The Boelus series consists of deep, well drained soils on uplands. These soils formed in eolian sands deposited over loamy sediments (fig. 15). Permeability is rapid in the upper part of the soil and moderate in the lower part. Slopes range from 0 to 3 percent.

The Boelus soils in Rock County are in a drier climate than is typical for the Boelus series. This difference, however, does not affect the use or behavior of the soils.

Boelus soils commonly are near Dunday, Jansen, Libory, Pivot, and Valentine soils. Dunday and Valentine soils are higher on the landscape and are sandy throughout. Jansen and Pivot soils are on landscape positions similar to those of the Boelus soils and have gravelly coarse sand or coarser sand at depths between 20 and 40 inches. Libory soils are moderately well drained and are lower on the landscape.

Typical pedon of Boelus loamy sand, 0 to 3 percent slopes, 700 feet north and 200 feet west of the southeast corner of sec. 6, T. 29 N., R. 19 W.

A1—0 to 7 inches; dark gray (10YR 4/1) loamy sand, black (10YR 2/1) moist; weak fine granular structure; soft, very friable; common medium and fine roots; medium acid; clear smooth boundary.

A2—7 to 14 inches; grayish brown (10YR 5/2) loamy sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable; common medium and fine roots; medium acid; clear smooth boundary.

BA—14 to 23 inches; brown (10YR 5/3) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak medium and fine subangular blocky structure parting to weak fine granular; slightly hard, very friable; common medium and fine roots; medium acid; abrupt smooth boundary.

2Bw—23 to 29 inches; brown (10YR 5/3) very fine sandy loam, dark brown (10YR 4/3) moist; weak coarse and medium prismatic structure parting to weak medium and fine subangular blocky; hard, friable; medium acid; clear smooth boundary.

2BC—29 to 37 inches; pale brown (10YR 6/3) very fine sandy loam, dark brown (10YR 4/3) moist; weak coarse and medium prismatic structure parting to weak coarse and medium subangular blocky; slightly hard, friable; medium acid; clear smooth boundary.

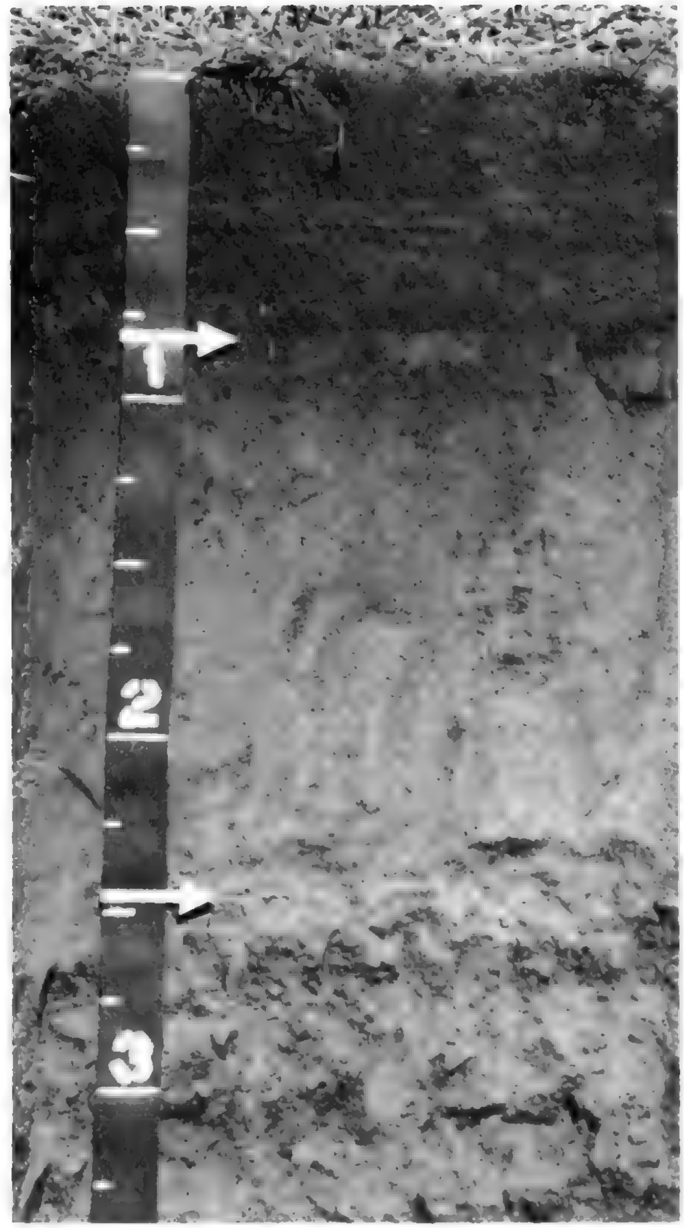

Figure 15.—Profile of a Boelus soil. The upper arrow marks the boundary of the surface layer. The lower arrow marks the contact between the sandy material and the underlying loamy material.

2C—37 to 60 inches; very pale brown (10YR 7/3) very fine sandy loam, brown (10YR 5/3) moist; massive; slightly hard, very friable; medium acid.

Thickness of the mollic epipedon ranges from 10 to 18 inches. Depth to the loamy 2B horizon ranges from 20 to 40 inches. Solum thickness ranges from 24 to 45 inches.

Some pedons have a C horizon above the 2B horizon. Reaction ranges from medium acid to moderately alkaline throughout the profile.

The A horizon has value of 3 through 5 (2 through 4 moist) and chroma of 1 through 3. It dominantly is loamy sand, but the range includes loamy fine sand. The 2Bw and 2C horizons have value of 5 through 7 (4 through 6 moist) and chroma of 2 through 4. Texture is very fine sandy loam, loam, silt loam, or silty clay loam. In some pedons, the 2C horizon contains carbonates.

Brunswick Series

The Brunswick series consists of moderately deep, well drained, moderately rapidly permeable soils on uplands (fig. 16). These soils formed in residuum of weakly cemented sandstone bedrock. Slopes range from 3 to 30 percent.

The Brunswick soils in Rock County are in a drier climate and are higher in pH than is typical for the Brunswick series. These differences do not affect the use or behavior of the soils.

Brunswick soils are adjacent to Meadin, O'Neill, Tassel, and Valentine soils. Meadin and O'Neill soils are on higher positions. Meadin soils have gravelly coarse sand at a depth of 20 inches or less. O'Neill soils have gravelly coarse sand at a depth of 20 to 40 inches. Tassel soils are higher on the landscape than the Brunswick soils and have weakly cemented sandstone at a depth of 10 to 20 inches. Valentine soils are sandy and are in hummocky areas.

Typical pedon of Brunswick loamy sand, in an area of Brunswick-Tassel loamy sands, 3 to 11 percent slopes, 1,500 feet north and 600 feet east of the southwest corner of sec. 32, T. 32 N., R. 18 W.

Ap—0 to 4 inches; dark grayish brown (2.5Y 4/2) loamy sand, very dark grayish brown (2.5Y 3/2) moist; weak fine granular structure; soft, very friable; neutral; abrupt smooth boundary.

Bw—4 to 12 inches; grayish brown (2.5Y 5/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak coarse and medium prismatic structure parting to weak medium and fine subangular blocky; hard, friable; neutral; clear smooth boundary.

BC—12 to 19 inches; light gray (2.5Y 7/2) fine sandy loam, grayish brown (2.5Y 5/2) moist; weak medium and coarse prismatic structure parting to medium and fine subangular blocky; slightly hard, friable; neutral; gradual wavy boundary.

C—19 to 24 inches; light gray (2.5Y 7/2) loamy fine sand, grayish brown (2.5Y 5/2) moist; weak coarse prismatic structure; slightly hard, friable; strong effervescence; neutral; gradual wavy boundary.

Cr—24 to 60 inches; white (2.5Y 8/2) weathered sandstone; light gray (2.5Y 7/2) moist; massive; very hard, very firm; violent effervescence; mildly alkaline.

Figure 16.—Profile of Brunswick fine sandy loam, which is moderately deep and formed in residuum of soft sandstone bedrock. The arrow marks the lower boundary of the surface layer. The scale is in feet.

Thickness of the solum ranges from 12 to 28 inches. Depth to soft sandstone bedrock ranges from 20 to 40 inches.

The A horizon has hue of 10YR or 2.5Y, value of 4 through 6 (3 or 4 moist), and chroma of 1 or 2. The A horizon ranges from 4 to 12 inches in thickness. The A horizons having value of less than 5.5 dry or 3.5 moist are less than 7 inches thick. Texture is dominantly loamy sand, but the range includes loam, fine sandy loam, and loamy fine sand. The A horizon is medium acid to neutral. The B horizon has hue of 10YR or 2.5Y, value of 5 through 7 (4 or 5 moist), and chroma of 2 or 3. It is typically fine sandy loam but includes loam averaging less than 18 percent clay. The B horizon is medium acid or neutral. The C horizon has hue of 2.5Y or 5Y, value of 6 through 8 (5 through 7 moist), and chroma of 2 or 3. It ranges from fine sandy loam, sandy loam, and loamy fine sand to fine sand. Reaction is slightly acid to mildly alkaline. The Cr horizon has colors similar to those of the C horizon.

Duda Series

The Duda series consists of moderately deep, well drained, rapidly permeable soils on upland breaks to the Niobrara River Valley. These soils formed in eolian sand overlying calcareous sandstone. Slopes range from 15 to 25 percent.

Duda soils commonly are adjacent to Brunswick, Labu, Sansarc, Tassel, and Valentine soils. Brunswick soils contain less sand in the solum. Labu and Sansarc soils are on lower side slopes. Labu soils are moderately deep over bedded shale, and Sansarc soils are shallow over bedded shale. Tassel soils are shallow to sandstone. Valentine soils are deep sandy soils.

Typical pedon of Duda loamy sand, in an area of Tassel-Valentine-Duda complex, 15 to 70 percent slopes, 1,800 feet east and 1,200 feet south of the northwest corner of sec. 28, T. 31 N., R. 20 W.

A—0 to 6 inches; grayish brown (10YR 5/2) loamy sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; slightly acid; clear smooth boundary.

AC—6 to 15 inches; light brownish gray (10YR 6/2) loamy sand, dark grayish brown (10YR 4/2) moist; weak medium and fine subangular blocky structure parting to weak fine granular; soft, very friable; neutral; clear smooth boundary.

C1—15 to 25 inches; pale brown (10YR 6/3) loamy sand, grayish brown (10YR 5/2) moist; single grain; soft, very friable; neutral; clear smooth boundary.

C2—25 to 32 inches; light gray (10YR 7/2) loamy sand, pale brown (10YR 6/3) moist; single grain; soft, very friable; slight effervescence; mildly alkaline; clear smooth boundary.

Cr—32 to 60 inches; white (10YR 8/2) sandstone, very pale brown (10YR 7/3) moist; difficult to dig with spade; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 12 to 24 inches, and the depth to sandstone bedrock ranges from 20 to 40 inches. Carbonates are generally leached to the C horizon. The dark colors in the surface layer extend to a depth of 6 to 9 inches. Reaction is slightly acid to mildly alkaline.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It is loamy sand or loamy fine sand. The AC horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 through 3. It is loamy sand, loamy fine sand, or fine sand. The C horizon has value of 5 through 7 (4 through 6 moist) and chroma of 2 through 4. It is loamy sand, loamy fine sand, or fine sand. The Cr horizon is similar in color to the C horizon or is lighter colored. It is weakly to strongly cemented sandstone, which is not always continuous in respect to depth.

Dunday Series

The Dunday series consists of deep, well drained, rapidly permeable soils on uplands. These soils formed in eolian sand. Slopes range from 0 to 3 percent.

Dunday soils are similar to Pivot soils and commonly are adjacent to Boelus, Elsmere, and Valentine soils. Pivot soils are underlain by coarse sand at depths between 20 and 40 inches. Boelus soils have loamy underlying material. Elsmere soils are somewhat poorly drained and are lower than Dunday soils on the landscape. Valentine soils, which are higher on the landscape, do not have a mollic epipedon.

Typical pedon of Dunday loamy fine sand, 0 to 3 percent slopes, 200 feet east and 900 feet north of the southwest corner of sec. 30, T. 29 N., R. 19 W.

Ap—0 to 11 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable; common fine and medium roots; neutral; clear smooth boundary.

AC—11 to 22 inches; grayish brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak coarse and medium prismatic structure parting to weak fine and medium subangular blocky; slightly hard, very friable; common fine and medium roots; neutral; gradual smooth boundary.

C1—22 to 32 inches; light brownish gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) moist; single grain; very friable; common fine and medium roots; neutral; gradual smooth boundary.

C2—32 to 60 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; single grain; soft, very friable; few medium and fine roots; neutral.

Thickness of the solum ranges from 14 to 26 inches. Thickness of the mollic epipedon ranges from 10 to 15 inches. Reaction is slightly acid or neutral.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is loamy sand and loamy fine sand. The AC horizon has a value of 4 through 6 (3 or 4 moist) and chroma of 2 or 3. The C horizon has value of 5 through 7 (4 through 6 moist) and chroma of 2 through 4. It is fine sand, loamy fine sand, loamy sand, and sand.

Els Series

The Els series consists of deep, somewhat poorly drained, rapidly permeable soils that formed in mixed eolian and alluvial sands. These soils are on the bottoms of sandhill valleys and on bottom lands. Slopes range from 0 to 3 percent.

Els soils are similar to Elsmere soils and commonly are adjacent to Elsmere, Ipage, Loup, Tryon, and Valentine soils. Elsmere soils have a mollic epipedon. Ipage soils are slightly higher on the landscape than Els soils and are moderately well drained. Loup and Tryon soils are lower on the landscape and are poorly drained and very poorly drained. Valentine soils are on the higher hummocky landscapes and are somewhat excessively drained and excessively drained.

Typical pedon of Els loamy sand, in an area of Els-Ipage complex, 0 to 3 percent slopes, 1,000 feet west and 700 feet south of the northeast corner of sec. 1, T. 27 N., R. 19 W.

A—0 to 9 inches; grayish brown (10YR 5/2) loamy sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; many medium and fine roots; slightly acid; clear smooth boundary.

AC—9 to 14 inches; light brownish gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) moist; weak fine granular structure; soft, very friable; few medium and fine roots; slightly acid; clear smooth boundary.

C1—14 to 22 inches; pale brown (10YR 6/3) fine sand, light brownish gray (10YR 6/2) moist; few fine and medium distinct yellowish brown (10YR 5/6 moist) mottles; single grain; loose; neutral; clear smooth boundary.

C2—22 to 60 inches; very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; common fine and medium prominent strong brown (7.5YR 5/6 moist) mottles; single grain; loose; neutral.

Thickness of the solum ranges from 8 to 18 inches. Els soils range from slightly acid to moderately alkaline throughout.

The A horizon has value of 4 or 5 (3 moist) and chroma of 1 or 2. It is fine sand, loamy sand, or loamy fine sand and ranges from 6 to 9 inches in thickness. The AC horizon has value of 5 or 6 (4 or 5 moist) and chroma of 1 through 3. It is typically fine sand, but in some pedons, it is loamy sand, sand, and loamy fine sand. The C horizon has value of 5 through 8 (4 through 7 moist) and chroma of 2 or 3. It is typically fine sand, but some pedons are sand or loamy sand. The mottles in the C horizon are yellowish brown or strong brown. In some pedons, dark buried loamy fine sand or fine sand horizons about 2 to 8 inches thick are between depths of 15 and 40 inches. In some pedons, coarse sand or gravelly coarse sand is below a depth of 40 inches.

Elsmere Series

The Elsmere series consists of deep, somewhat poorly drained, rapidly permeable soils that formed in mixed eolian and alluvial sands. These soils are on bottom lands. Slopes range from 0 to 3 percent.

Elsmere soils are similar to Els soils and commonly are adjacent to Ipage, Loup, Selia, and Tryon soils. Els soils do not have a mollic epipedon. Ipage soils are higher on the landscape than Elsmere soils and are moderately well drained. Loup and Tryon soils are lower on the landscape and are poorly drained or very poorly drained. Selia soils are on similar positions on the landscape. Selia soils are high in sodium content.

Typical pedon of Elsmere loamy fine sand, 0 to 2 percent slopes, 250 feet east and 200 feet north of the southwest corner of sec. 34, T. 30 N., R. 19 W.

A1—0 to 12 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark gray (10YR 3/1) moist; weak fine granular structure; soft, very friable; common fine and medium roots; neutral; clear smooth boundary.

A2—12 to 19 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; common fine and medium roots; neutral; clear smooth boundary.

AC—19 to 24 inches; grayish brown (10YR 5/2) sand, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; common fine and medium roots; neutral; abrupt smooth boundary.

C1—24 to 27 inches; light brownish gray (10YR 6/2) sand, grayish brown (10YR 5/2) moist; single grain; soft, loose; few fine roots; moderately alkaline; abrupt smooth boundary.

C2—27 to 32 inches; grayish brown (10YR 5/2) loamy sand, dark grayish brown (10YR 4/2) moist; few fine distinct dark yellowish brown (10YR 4/4 moist) mottles; weak medium and fine subangular blocky structure; slightly hard, friable; moderately alkaline; clear smooth boundary.

C3—32 to 60 inches; light brownish gray (10YR 6/2) sand, grayish brown (10YR 5/2) moist; common fine distinct dark yellowish brown (10YR 4/4 moist) and few fine distinct very dark gray (10YR 3/1 moist) mottles; single grain; slightly hard, loose; moderately alkaline.

Thickness of the mollic epipedon ranges from 10 to 19 inches. Thickness of the solum ranges from 10 to 36 inches. Reaction is slightly acid through moderately alkaline.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is fine sand, loamy sand, or loamy fine sand. The AC horizon has value of 4 through 6 (2 through 4 moist) and chroma of 1 or 2. It is sand, fine sand, loamy sand, or loamy fine sand. The C horizon has value of 5 through 7 (4 through 6 moist) and chroma of 2 or 3. It is typically sand and less commonly loamy sand or fine sand. Mottles in the C horizon range from few to many.

Ipage Series

The Ipage series consists of deep, moderately well drained, rapidly permeable soils that formed in eolian and alluvial sands. These soils are on low hummocky slopes or low ridges in sandhill valleys and in the Elkhorn River Valley. Slopes range from 0 to 6 percent.

Ipage soils commonly are adjacent to Els, Elsmere, Tryon, and Valentine soils. Els and Elsmere soils are lower on the landscape than Ipage soils and are somewhat poorly drained. Elsmere soils have a mollic epipedon. Tryon soils are on the lowest parts of the landscape and are poorly drained and very poorly drained. Valentine soils are higher on the landscape and are excessively drained.

Typical pedon of Ipage fine sand, in an area of Els-Ipage complex, 0 to 3 percent slopes, 950 feet south and 50 feet west of the northeast corner of sec. 1, T. 27 N., R. 19 W.

A—0 to 5 inches; grayish brown (10YR 5/2) fine sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; common very fine and fine roots; medium acid; clear wavy boundary.

AC—5 to 16 inches; brown (10YR 5/3) fine sand, dark grayish brown (10YR 4/2) moist; single grain; loose; common very fine and fine roots; medium acid; gradual wavy boundary.

C1—16 to 24 inches; light brownish gray (10YR 6/2) fine sand, brown (10YR 5/3) moist; single grain; loose; few fine and very fine roots; slightly acid; gradual wavy boundary.

C2—24 to 44 inches; pale brown (10YR 6/3) fine sand, light brownish gray (10YR 6/2) moist; few fine faint grayish brown (10YR 5/2 moist) mottles; single grain; loose; slightly acid; gradual wavy boundary.

C3—44 to 54 inches; light gray (10YR 7/2) fine sand, light brownish gray (10YR 6/2) moist; few fine faint grayish brown (10YR 5/2 moist) mottles; single grain; loose; slightly acid; gradual wavy boundary.

C4—54 to 60 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; few medium faint dark yellowish brown (10YR 4/4 moist) mottles; single grain; loose; medium acid.

Thickness of the solum ranges from 6 to 20 inches. Reaction ranges from medium acid to neutral throughout.

The A horizon has value of 4 through 6 (3 or 4 moist) and chroma of 1 or 2. It is sand, fine sand, loamy sand, or loamy fine sand. The AC horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 or 3. It is sand, fine sand, or loamy sand. The C horizon has value of 6 through 8 (4 through 6 moist) and chroma of 2 or 3. It has few to common distinct and prominent mottles within a depth of 40 inches. Mottles are gray through yellowish brown. The C horizon is typically fine sand and less commonly sand or loamy sand. In some pedons, coarse sand or gravelly coarse sand is common at depths below 40 inches.

Jansen Series

The Jansen series consists of well drained soils on uplands. These soils formed in loamy outwash in eolian material that is moderately deep over sand and gravelly sand. They have moderate permeability in the solum and very rapid permeability in the underlying material. They formed mainly in loamy and sandy material overlying coarse sand. Slopes range from 0 to 3 percent.

Jansen soils commonly are adjacent to Boelus, Pivot, Meadin, and Valentine soils. Boelus soils have loamy underlying material. In contrast to Jansen soils, Pivot soils do not have a loamy subsoil. Meadin soils, which are lower on the landscape, are gravelly coarse sand between depths of 8 and 20 inches. Valentine soils are higher on the landscape and are sandy throughout.

Typical pedon of Jansen loamy sand, 0 to 3 percent slopes, 1,400 feet north and 300 feet west of the center of sec. 2, T. 30 N., R. 20 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loamy sand, dark brown (10YR 3/3) moist; weak fine granular structure; slightly hard, very friable; neutral; abrupt smooth boundary.

A2—7 to 11 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak granular structure; slightly hard, very friable; neutral; clear smooth boundary.

Bt1—11 to 15 inches; pale brown (10YR 6/3) clay loam, brown (10YR 4/3) moist; weak fine and medium subangular blocky structure; very hard, firm; neutral; clear smooth boundary.

Bt2—15 to 24 inches; light yellowish brown (10YR 6/4) clay loam, brown (10YR 5/3) moist; moderate fine and medium subangular blocky structure; very hard, firm; neutral; clear smooth boundary.

2C—24 to 60 inches; very pale brown (10YR 8/3) coarse sand, pale brown (10YR 6/3) moist; single grain; loose; 5 percent gravel by volume; neutral.

Solum thickness and depth to coarse sand or gravelly coarse sand range from 20 to 27 inches. In some pedons, pebbles are on the surface and are mixed throughout. The mollic epipedon ranges from 7 to 15 inches in thickness and may extend into the B horizon. The profile is strongly acid to neutral throughout.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. The texture dominantly is loamy sand and loamy fine sand, but the range includes sandy loam and fine sandy loam. The Bt horizon has value of 4 through 6 (3 through 5 moist) and chroma of 2 through 4. It is loam, clay loam, or sandy clay loam that averages between 18 and 32 percent clay. The 2C horizon has value of 5 through 8 (4 through 6 moist) and chroma of 3 or 4. The texture of the 2C horizon generally is coarse sand that is 5 to 15 percent gravel by volume, but the range includes sand, gravelly sand, and gravelly coarse sand.

Labu Series

The Labu series consists of moderately deep, well drained, slowly permeable soils on breaks to the Niobrara River Valley. These soils formed in residuum of clayey shale (fig. 17). Slopes range from 11 to 30 percent.

Labu soils commonly are adjacent to Brunswick, Sansarc, Simeon, and Valentine soils. Brunswick soils are higher on the landscape and formed from weathered soft sandstone. Sansarc soils are steeper than Labu soils and are less than 20 inches deep over bedded shale. The Simeon and Valentine soils, which are deep and sandy, generally are on landscape positions above Labu soils.

Typical pedon of Labu silty clay, in an area of Labu-Sansarc silty clays, 11 to 40 percent slopes, 1,000 feet north and 700 feet west of the center of sec. 30, T. 32 N., R. 19 W.

A—0 to 6 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; hard, friable; common medium and fine roots; neutral; clear smooth boundary.

Bw1—6 to 17 inches; brown (10YR 5/3) silty clay, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, friable; common fine and medium roots; strong effervescence; mildly alkaline; clear smooth boundary.

Bw2—17 to 24 inches; light yellowish brown (2.5Y 6/4) silty clay, dark grayish brown (2.5Y 4/2) moist; weak medium and coarse prismatic structure parting to moderate medium and fine subangular blocky; very hard, very firm; common fine roots; violent effervescence; mildly alkaline; clear smooth boundary.

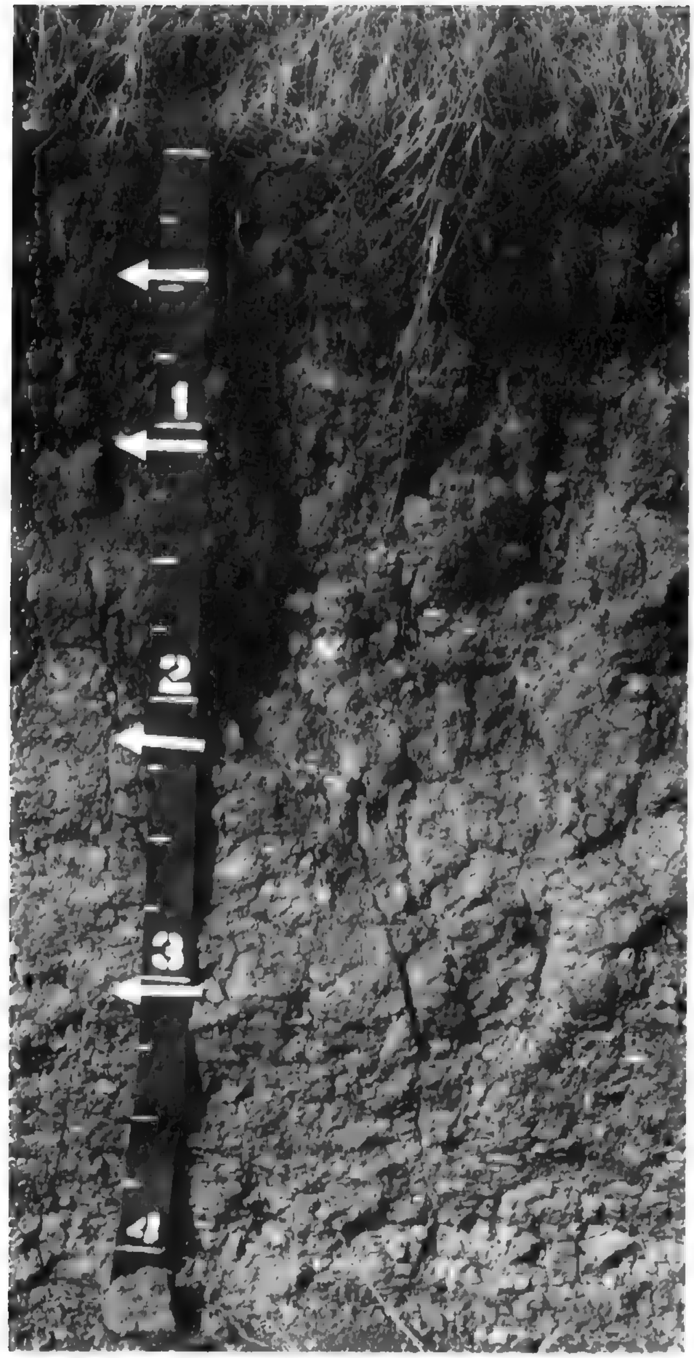

Figure 17.—Profile of Labu silty clay, which formed in residuum of clayey shale. The lowermost arrow marks the upper boundary of the bedded shale. The scale is in feet.

C—24 to 35 inches; light yellowish brown (2.5Y 6/4) shaly clay, olive (5Y 5/3) moist; massive; very hard, very firm; few fine roots in the upper 5 inches; few

distinct lime concretions; violent effervescence; mildly alkaline; clear smooth boundary.

Cr—35 to 60 inches; light yellowish brown (2.5Y 6/4) shale, olive (5Y 5/3) moist; massive breaking to moderate medium and coarse platy shale fragments; very hard, very firm; violent effervescence; mildly alkaline.

Thickness of the solum ranges from 20 to 28 inches. Depth to bedded shale ranges from 20 to 40 inches. Reaction ranges from neutral to moderately alkaline throughout. Cracks that range up to 1 1/2 inches wide and several feet long commonly extend throughout the solum when the soil is dry.

The A horizon has hue of 10YR or 2.5Y, value of 4 through 6 (3 through 5 moist) and chroma of 2 or 3. Texture dominantly is silty clay, but the range includes clay. The A horizon ranges from 4 to 6 inches in thickness. The Bw horizon has hue of 10YR, 2.5Y, and 5Y, value of 5 or 6 (4 or 5 moist), and chroma of 2 through 4. It is silty clay or clay. The C horizon has hue of 10YR, 2.5Y, and 5Y, value of 5 through 7 (4 through 6 moist), and chroma of 2 through 4. It is shaly clay or clay. The Cr horizon has hue of 10YR, 2.5Y, and 5Y, value of 6 or 7 (3 through 6 moist), and chroma of 2 through 4. Platy shale fragments in this horizon are medium or coarse.

Libory Series

The Libory series consists of deep, moderately well drained soils on uplands. Permeability is rapid in the upper part of the soil and moderately slow in the lower part. The upper part of the soil formed in reworked eolian sand, and the lower part formed in loamy or silty alluvium. Slopes range from 0 to 3 percent.

Libory soils are adjacent to Dunday, Els, Elsmere, and Valentine soils. Dunday soils are on higher positions than Libory soils and have a sandy control section. The Dunday soils are somewhat excessively drained. Els and Elsmere soils are sandy, somewhat poorly drained soils that are lower on the landscape. Valentine soils are deep, sandy, excessively drained soils on the highest part of the landscape.

Typical pedon of Libory loamy fine sand, 0 to 3 percent slopes, 400 feet east and 1,700 feet south of the northwest corner of sec. 29, T. 30 N., R. 19 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; common medium and fine roots; slightly acid; abrupt smooth boundary.

A—6 to 14 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark gray (10YR 3/1) moist; weak fine and medium subangular blocky structure parting to weak fine granular; soft, very friable; common medium and fine roots; slightly acid; gradual smooth boundary.

C—14 to 24 inches; grayish brown (10YR 5/2) fine sand, dark grayish brown (10YR 4/2) moist; single grain; soft, very friable; common medium and fine roots; slightly acid; abrupt smooth boundary.

2Bwb—24 to 32 inches; brown (10YR 5/3) loam, dark grayish brown (2.5Y 4/2) moist; many medium prominent strong brown (7.5YR 5/6 moist) mottles; weak coarse and medium subangular blocky structure; very hard, firm; sand seams up to 1/4 inch thick on many of the ped faces; neutral; abrupt smooth boundary.

2C1—32 to 38 inches; light gray (2.5Y 7/2) loam, grayish brown (2.5Y 5/2) moist; many medium prominent dark brown (7.5YR 4/4 moist) mottles; massive; very hard, firm; neutral; clear smooth boundary.

2C2—38 to 60 inches; light gray (2.5Y 7/2) loam, grayish brown (2.5Y 5/2) moist; many medium prominent dark brown (7.5YR 4/4 moist) mottles; massive; very hard, firm; few medium calcium carbonate accumulations; neutral.

The mollic epipedon ranges from 10 to 15 inches in thickness. The depth to the loamy or silty 2Bwb horizon ranges from 20 to 36 inches. Reaction ranges from medium acid to mildly alkaline.

The A horizon has value of 3 through 5 (2 through 4 moist) and chroma of 1 or 2. Texture is dominantly loamy fine sand, but the range includes loamy sand and fine sand. The C horizon has value of 5 through 7 (4 through 6 moist) and chroma of 2 or 3. The texture typically is fine sand, but the range also includes loamy sand or loamy fine sand. The 2Bwb horizon has hue of 10YR or 2.5Y, value of 4 through 6 (3 through 5 moist), and chroma of 2 or 3. It typically is loam, but the range includes very fine sandy loam, silt loam, and silty clay loam. Mottles in this horizon range from few to many and are distinct or prominent. The 2C horizon has hue of 2.5Y, 5Y, or 10YR, value of 4 through 7 (3 through 6 moist), and chroma of 2 or 3. It typically is loam, but the range includes silt loam, silty clay loam, and very fine sandy loam. Mottles in the 2C horizon range from few to many and are distinct or prominent.

Loup Series

The Loup series consists of deep, poorly drained and very poorly drained, rapidly permeable soils formed in sandy alluvium. These soils occur on bottom lands along rivers and around lakes and marshes in the sandhills. Slopes range from 0 to 2 percent.

Loup soils are similar to Tryon soils and are adjacent to Els, Elsmere, Ipage, and Marlake soils. Tryon soils do not have a mollic epipedon. Els and Elsmere soils are higher on the landscape than Loup soils and are somewhat poorly drained. Ipage soils are higher on the

landscape than Loup soils and are moderately well drained. The Marlake soils do not have a mollic epipedon, have a higher seasonal water table, and are lower on the landscape.

Typical pedon of Loup fine sandy loam, 0 to 2 percent slopes, 600 feet south and 400 feet west of the northeast corner of sec. 18, T. 30 N., R. 18 W.

A1—0 to 7 inches; very dark gray (10YR 3/1) fine sandy loam, black (10YR 2/1) moist; weak fine granular structure; soft, very friable; common fine and medium roots; strong effervescence; mildly alkaline; clear wavy boundary.

A2—7 to 10 inches; dark gray (10YR 4/1) fine sandy loam, very dark gray (10YR 3/1) moist; weak fine and medium subangular blocky structure parting to weak fine granular; slightly hard, friable; common fine and medium roots; mildly alkaline; clear wavy boundary.

ACg—10 to 14 inches; gray (5Y 5/1) loamy sand, dark gray (5Y 4/1) moist; few fine faint grayish brown (10YR 5/2 moist) mottles; weak fine and medium subangular blocky structure parting to weak fine granular; slightly hard, friable; common medium roots; neutral; clear smooth boundary.

Cg1—14 to 29 inches; light gray (5Y 7/1) fine sand, gray (5Y 5/1) moist; few fine distinct yellowish brown (10YR 5/4 moist) mottles; single grain; loose; few medium roots; neutral; clear smooth boundary.

Cg2—29 to 35 inches; light gray (5Y 6/1) loamy sand, gray (10YR 5/1) moist; many fine prominent (5Y 4/3 moist) mottles; weak medium and fine subangular blocky structure; slightly hard, friable; neutral; clear smooth boundary.

Cg3—35 to 60 inches; light gray (5Y 7/1) fine sand, gray (5Y 6/1) moist; few fine distinct yellowish brown (10YR 5/4 moist) mottles; single grain; loose; neutral.

Thickness of the solum ranges from 10 to 22 inches. The mollic epipedon ranges from 7 to 20 inches in thickness. The upper 5 to 15 inches is calcareous in most pedons. Reaction is neutral to moderately alkaline.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 1 or 2. Texture typically is a fine sandy loam, but the range includes loam, loamy fine sand, and loamy sand. The AC horizon has hue of 10YR or 5Y, value of 5 or 6 (3 through 5 moist), and chroma of 1 or 2. It is loamy sand, fine sand, or sand. The AC horizon commonly contains few or common, fine or medium, faint or distinct, grayish brown mottles. The Cg horizon has hue of 5Y or 10YR, value of 6 through 8 (4 through 7 moist), and chroma of 1 through 2. It is fine sand, sand, or loamy sand. It contains few or common, faint or distinct olive or yellowish brown mottles.

Marlake Series

The Marlake series consists of deep, very poorly drained, rapidly permeable soils that formed in colluvium or alluvium covered with eolian sand (fig. 18). These soils are in depressions or basins of valley floors and in low areas bordering lakes and streams. Because of a high water table, these soils are ponded most of the growing season. Slopes range from 0 to 1 percent.

Marlake soils are adjacent to Els, Elsmere, Loup, and Tryon soils. Els and Elsmere soils are higher on the landscape than Marlake soils and are somewhat poorly drained. Loup and Tryon soils are on slightly higher positions than Marlake soils. Elsmere and Loup soils have a mollic epipedon. Tryon soils are less stratified.

Typical pedon of Marlake loamy fine sand, 0 to 1 percent slopes, 1,100 feet west and 1,200 feet north of the southeast corner of sec. 2, T. 27 N., R. 19 W.

A—0 to 8 inches; dark gray (10YR 4/1) loamy fine sand, black (10YR 2/1) moist; weak fine granular structure; soft, very friable; many fine medium and coarse roots; on the surface is a layer of partially decomposed leaves and stems; neutral; abrupt wavy boundary.

Cg—8 to 12 inches; light brownish gray (2.5Y 6/2) fine sand, grayish brown (2.5Y 5/2) moist; weak medium subangular blocky structure parting to weak fine granular; soft, very friable; many fine and medium roots; many fine strata of sandy loam and loamy sand; neutral; abrupt wavy boundary.

Ab—12 to 19 inches; dark grayish brown (2.5Y 4/2) loamy sand, very dark gray (10YR 3/1) moist; common medium distinct yellowish brown (10YR 5/4 moist) mottles; soft, very friable; neutral; abrupt wavy boundary.

Cg —19 to 60 inches; white (5Y 8/1) sand, light gray (5Y 6/1) moist; few fine distinct pale olive (5Y 6/4 moist) mottles; single grain; loose; neutral.

The thickness of the solum ranges from 6 to 25 inches. The mollic colors range from 6 to 10 inches in thickness. Some pedons are calcareous at the surface. Snail shells are common. In some pedons, an AC horizon is present.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It dominantly is loamy fine sand, but the range includes loamy sand and fine sandy loam. Reaction is neutral to moderately alkaline. The C horizon has hue of 10YR, 2.5Y, and 5Y, value of 5 through 7 (4 through 6 moist), and chroma of 1 through 3. It is sand or fine sand containing strata of finer and coarser textured material, and dark buried layers are common. The Cg horizon is neutral or mildly alkaline, and a few pedons have layers of carbonate accumulations in the upper part of the Cg horizon. The Cg horizon contains

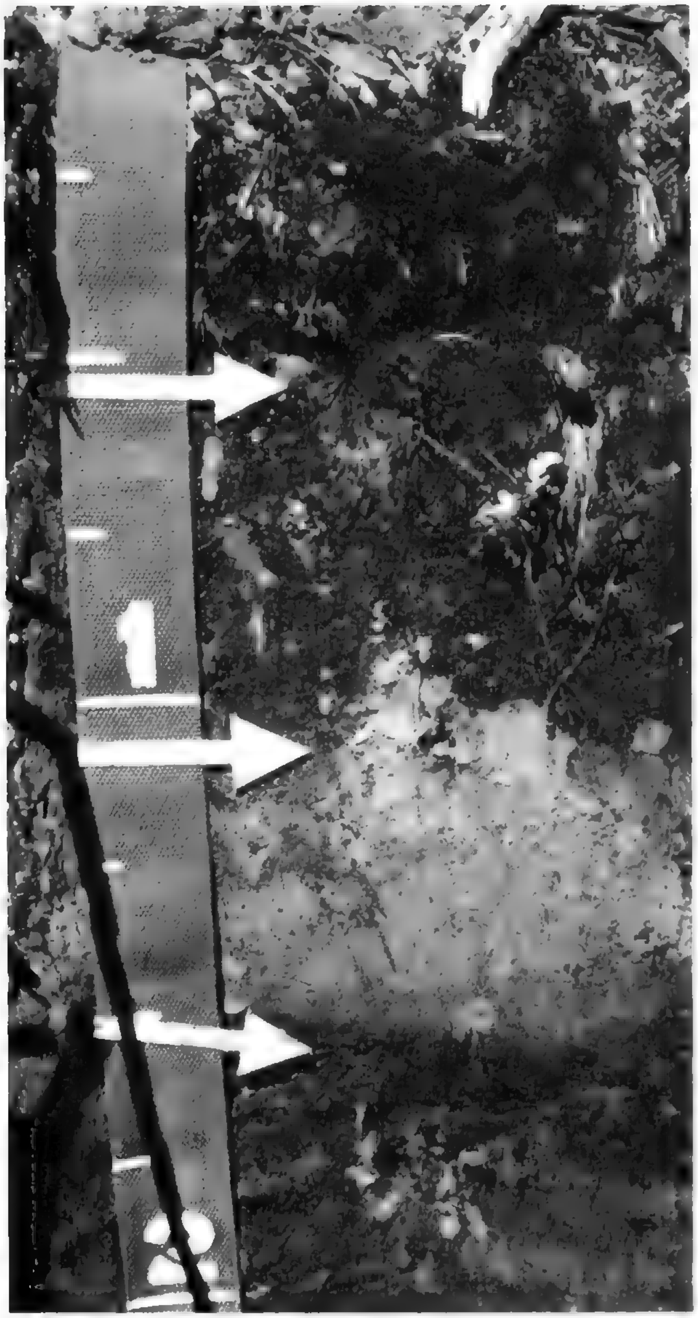

Figure 18.—Profile of Marlake loamy fine sand, 0 to 1 percent slopes. The upper marker indicates the lower boundary of a layer of partly decayed leaves and stems. The middle marker is the lower boundary of the dark surface layer. The lower marker is the wavy boundary between the C horizon and a buried soil. The scale is in feet.

few or common, faint to prominent, yellowish brown or pale olive mottles.

Meadin Series

The Meadin series consists of excessively drained soils on uplands and side slopes along drainageways. These soils are shallow over coarse sand and gravelly coarse sand. Permeability is rapid in the upper part of the soil and very rapid in the lower part. Slopes range from 0 to 11 percent.

Meadin soils are adjacent to Jansen, O'Neill, Pivot, Simeon, and Valentine soils. Jansen, O'Neill, and Pivot soils are moderately deep over sand and gravel material. Simeon and Valentine soils do not have a mollic epipedon.

Typical pedon of Meadin sandy loam, 0 to 3 percent slopes, 1,600 feet east and 1,100 feet north of the southwest corner of sec. 25, T. 32 N., R. 17 W.

A—0 to 4 inches; dark grayish brown (10YR 4/2) sandy loam, black (10YR 2/1) moist; weak fine granular structure; soft, very friable; neutral; abrupt smooth boundary.

AC—4 to 8 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; weak fine granular structure; soft, very friable; neutral; abrupt smooth boundary.

2C1—8 to 24 inches; light yellowish brown (10YR 6/4) coarse sand, brown (10YR 5/3) moist; single grain; loose; 5 percent gravel by volume; neutral; clear smooth boundary.

2C2—24 to 60 inches; pale brown (10YR 6/3) gravelly coarse sand, brown (10YR 5/3) moist; single grain; loose; 20 percent gravel by volume; neutral.

The thickness of the solum ranges from 8 to 20 inches. The thickness of the mollic epipedon ranges from 7 to 20 inches. Depth to a mixture of sand and gravel ranges from 8 to 20 inches. Reaction ranges from medium acid to neutral.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It dominantly is sandy loam but includes loam, fine sandy loam, loamy fine sand, or loamy sand. The AC horizon has value of 4 through 6 (3 or 4 moist) and chroma of 2 through 4. It typically is sandy loam, gravelly sandy loam, loamy sand, or gravelly loamy sand. The 2C horizon has value of 5 through 7 (4 through 6 moist) and chroma of 2 through 4. It is coarse sand, gravelly coarse sand, gravelly sand, and very gravelly coarse sand. The percentage of gravel in the 2C horizon ranges from 5 to 35 percent but generally averages 20 to 35 percent by volume. In some pedons, the 2C horizon is stratified with layers of finer textured material.

O'Neill Series

The O'Neill series consists of well drained soils on uplands and side slopes along drainageways. These

soils formed in loamy outwash or eolian material that is moderately deep over sand and gravelly sand. Permeability is moderately rapid in the upper part of the profile and very rapid in the lower part. Slopes range from 0 to 11 percent.

O'Neill soils are similar to Vetal soils and commonly are adjacent to Meadin, Pivot, Simeon, Valentine, and Vetal soils. Vetal soils occur lower on the landscape and have a dark surface layer more than 20 inches thick. Meadin soils have coarse sand and gravelly coarse sand between depths of 8 and 20 inches. Pivot soils have more sand in the control section and are somewhat excessively drained. In contrast to the O'Neill soils, Simeon and Valentine soils do not have a mollic epipedon and are excessively drained.

Typical pedon of O'Neill sandy loam, 2 to 6 percent slopes, 2,500 feet east and 450 feet north of the southwest corner of sec. 21, T. 32 N., R. 17 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) sandy loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, very friable; strongly acid; clear smooth boundary.

A—7 to 17 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak fine and medium subangular blocky structure parting to weak fine granular; soft, very friable; strongly acid; clear smooth boundary.

Bw1—17 to 24 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak coarse and medium prismatic structure parting to weak medium and coarse subangular blocky; soft, very friable; medium acid; clear smooth boundary.

Bw2—24 to 32 inches; pale brown (10YR 6/3) sandy loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to weak medium and coarse subangular blocky; slightly hard, very friable; 12 percent gravel by volume; medium acid; clear smooth boundary.

2C1—32 to 38 inches; very pale brown (10YR 7/3) sand, brown (10YR 5/3) moist; single grain; soft, friable; medium acid; clear smooth boundary.

2C2—38 to 60 inches; very pale brown (10YR 8/3) gravelly sand, pale brown (10YR 6/3) moist; single grain; soft, friable; medium acid.

The mollic epipedon ranges from 7 to 20 inches in thickness and extends into the Bw horizon in some pedons. The solum thickness ranges from 20 to 40 inches. Reaction ranges from strongly acid to neutral.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It dominantly is sandy loam, loam, loamy fine sand, fine sandy loam, or loamy sand. The Bw horizon is fine sandy loam or sandy loam that has value of 4 through 6 (3 or 4 moist) and chroma of 2 through 4. In places, clay has accumulated in the lower part of the Bw horizon so the layer is noticeably finer textured than the layer above or below. The 2C horizon has value of 6 through 8 (5 or 6 moist) and chroma of 3 or 4. It is sand, gravelly sand, coarse sand, or gravelly coarse sand.

Ord Series

The Ord series consists of deep, somewhat poorly drained soils on bottom lands. These soils formed in stratified alluvium. They are moderately rapidly permeable in the upper part of the profile and rapidly permeable in the lower part. Slopes range from 0 to 2 percent.

Ord soils are adjacent to Meadin, O'Neill, Pivot, and Vetal soils, which are on higher landscapes and are better drained. Meadin soils are shallow to sand and gravel. O'Neill and Pivot soils are moderately deep to sand and gravel. Pivot soils have a sandy solum. Vetal soils have a mollic epipedon thicker than 20 inches.

Typical pedon of Ord loam, 0 to 2 percent slopes, 2,550 feet south and 50 feet east of the northwest corner of sec. 36, T. 32 N., R. 18 W.

Apk—0 to 7 inches; very dark grayish brown (10YR 3/2) loam, black (10YR 2/1) moist; weak fine granular structure; soft, very friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

Ak1—7 to 11 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak medium and coarse subangular blocky structure parting to weak fine granular; soft, very friable; strong effervescence; moderately alkaline; clear smooth boundary.

Ak2—11 to 18 inches; gray (10YR 5/1) loam, black (10YR 2/1) moist; weak medium and coarse prismatic structure parting to weak medium and coarse subangular blocky; soft, very friable; violent effervescence; moderately alkaline; clear smooth boundary.

ACk—18 to 21 inches; grayish brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; soft, very friable; slight effervescence; mildly alkaline; clear smooth boundary.

2C—21 to 27 inches; light brownish gray (10YR 6/2) sand, light brownish gray (10YR 6/2) moist; single grain; loose; mildly alkaline; clear smooth boundary.

Ab—27 to 38 inches; dark brownish gray (10YR 4/2) loamy sand, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; soft, very friable; neutral; clear smooth boundary.

2C1—38 to 60 inches; light brownish gray (10YR 6/2) sand, light brownish gray (10YR 6/2) moist; many medium distinct olive yellow (5Y 6/6 moist) mottles; single grain; loose; neutral.

Thickness of the solum ranges from 20 to 34 inches and commonly is the same as the depth to the

underlying sand. The mollic epipedon ranges from 10 to 20 inches in thickness. Carbonates are at or near the surface. Reaction ranges from mildly alkaline to moderately alkaline.

The A horizon has value of 3 through 5 (2 or 3 moist) and chroma of 1 or 2. It is loam or fine sandy loam. The AC horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2. It is fine sandy loam or sandy loam, but some pedons have thin strata of loamy fine sand. Few or common mottles are in the AC horizon in some pedons. The 2C horizon has value of 5 through 8 (4 through 6 moist) and chroma of 2. It has few or common distinct mottles. Texture dominantly is sand or fine sand, but some pedons contain strata of finer and coarser textured sediments.

Pivot Series

The Pivot series consists of somewhat excessively drained soils on uplands. These soils formed in sandy outwash or eolian sand over coarse sand or gravelly coarse sand (fig. 19). Permeability is rapid in the upper part of the profile and very rapid in the lower part. Slopes range from 0 to 3 percent.

Pivot soils are similar to Dunday soils and commonly are adjacent to Jansen, Meadin, O'Neill, and Valentine soils. Dunday soils are slightly higher on the landscape and do not contain gravel or coarse sand in the underlying material. Jansen and O'Neill soils have more clay in the subsoil. Meadin soils are lower on the landscape and have gravelly coarse sand between depths of 8 and 20 inches. Valentine soils do not have a mollic epipedon and are higher on the landscape.

Typical pedon of Pivot loamy sand, 0 to 3 percent slopes, 800 feet west and 300 feet north of the southeast corner of sec. 15, T. 31 N., R. 19 W.

A1—0 to 6 inches; dark grayish brown (10YR 4/2) loamy sand, black (10YR 2/1) moist; weak fine granular structure; soft, very friable; common very fine and fine roots; medium acid; clear smooth boundary.

A2—6 to 13 inches; grayish brown (10YR 5/2) loamy sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; common very fine and fine roots; slightly acid; clear smooth boundary.

AC—13 to 27 inches; brown (10YR 5/3) sand, dark grayish brown (10YR 4/2) moist; weak coarse and medium prismatic structure parting to weak fine and medium subangular blocky; soft, very friable; common fine roots; 1 percent gravel by volume; slightly acid; clear wavy boundary.

2C—27 to 60 inches; very pale brown (10YR 7/3) coarse sand, brown (10YR 5/3) moist; single grain; loose; few fine roots; 3 percent gravel by volume; slightly acid.

Figure 19.—Profile of Pivot loamy sand, 0 to 3 percent slopes. The upper arrow marks the lower boundary of the dark surface layer. The lower arrow marks the upper boundary of the coarse sand. The scale is in feet.

The mollic epipedon ranges from 10 to 20 inches in thickness and may extend into the AC horizon. Reaction ranges from medium acid to neutral. The depth to the 2C horizon is 20 to 40 inches. In some pedons, a C horizon is present.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. Texture dominantly is loamy sand, but the range includes loamy fine sand. The AC horizon has value of 4 or 5 (3 or 4 moist) and chroma of 2 or 3. It is sand, loamy coarse sand, or loamy sand. The 2C horizon has value of 5 through 7 (4 through 6 moist) and chroma of 2 through 4. It is coarse sand or gravelly coarse sand. The gravel content is 3 to 20 percent by volume.

Sansarc Series

The Sansarc series consists of shallow, well drained, slowly permeable soils on breaks to the Niobrara River Valley. These soils formed in clayey residuum of shale (fig. 20). Slopes range from 11 to 40 percent.

Sansarc soils are adjacent to Brunswick, Labu, Simeon, Valentine, and Tassel soils. Brunswick soils are higher on the landscape and formed from weathered sandstone. Labu soils are deeper than 20 inches to bedded shale. Simeon and Valentine soils are deep sandy soils, which occupy higher positions on the landscape. Tassel soils are shallow over weathered sandstone and are above the Sansarc soils on the landscape.

Typical pedon of Sansarc silty clay, in an area of Labu-Sansarc silty clays, 11 to 40 percent slopes, 1,100 feet west and 50 feet north of the center of sec. 30, T. 32 N., R. 19 W.

A—0 to 4 inches; grayish brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; moderate fine and medium granular structure; slightly hard, very friable; common medium and fine roots; slight effervescence; mildly alkaline; clear smooth boundary.

C1—4 to 11 inches; light brownish gray (2.5Y 6/2) shaly clay, dark grayish brown (2.5Y 4/2) moist; moderate medium granular structure; slightly hard, very friable; common medium and fine roots; slight effervescence; mildly alkaline; clear smooth boundary.

C2—11 to 18 inches; light brownish gray (2.5Y 6/2) very shaly clay, dark grayish brown (2.5Y 4/2) moist; weak medium and fine blocky structure parting to moderate medium and fine subangular blocky; slightly hard, friable; common medium and fine roots; slight effervescence; mildly alkaline; gradual smooth boundary.

Cr—18 to 60 inches; light brownish gray (2.5Y 6/2) bedded shale, dark grayish brown (2.5Y 4/2) moist; massive; few fine roots to 25 inches; shale partings have slight effervescence; mildly alkaline.

Figure 20.—Profile of Sansarc silty clay, a shallow soil formed in residuum of shale. The upper arrow marks the boundary between the surface layer and the underlying shaly clay. The lower arrow marks the upper boundary of the bedded shale. The scale is in feet.

Depth to bedded shale ranges from 4 to 20 inches. Reaction ranges from neutral to moderately alkaline.

The A horizon has hue of 10YR or 2.5Y, value of 4 through 6 (3 through 5 moist), and chroma of 2. It is silty clay or clay and ranges from 2 to 4 inches in thickness. The C horizon has hue of 2.5Y or 5Y, value of 5 or 6 (4 or 5 moist), and chroma of 2 through 4. Shale fragments make up as much as 50 percent or more of the volume of the C horizon. The Cr horizon is bedded shale and is similar in color to the C horizon.

Selia Series

The Selia series consists of deep, somewhat poorly drained soils formed in sandy alluvium or eolian sand on bottom lands. Permeability is slow in the solum and rapid in the underlying material. These soils contain large amounts of exchangeable sodium. Slopes range from 0 to 2 percent. In Rock County, Selia soils are mapped only in complex with Elsmere soils.

Selia soils commonly are adjacent to Els, Elsmere, Loup, Ipage, and Tryon soils, which are lower in content of exchangeable sodium. Els and Elsmere soils are somewhat poorly drained. Elsmere and Loup soils have a mollic epipedon. Ipage soils are moderately well drained and are on slightly higher positions on the landscape. Tryon and Loup soils, which are lower on the landscape, are poorly drained and very poorly drained.

Typical pedon of Selia loamy fine sand, in an area of Elsmere-Selia loamy fine sands, 0 to 3 percent slopes, 1,050 feet west and 450 feet south of the northeast corner of sec. 12, T. 30 N., R. 17 W.

A—0 to 3 inches; gray (10YR 5/1) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; mildly alkaline; abrupt smooth boundary.

E—3 to 4 inches; light gray (10YR 6/1) fine sand, dark gray (10YR 4/1) moist; single grain; soft, very friable; very strongly alkaline; strong effervescence; abrupt smooth boundary.

Btn1—4 to 8 inches; dark grayish brown (10YR 4/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak coarse columnar structure parting to coarse and medium subangular blocky; few medium and fine yellowish brown (10YR 5/6 moist) mottles; slightly hard, very friable; strong effervescence; very strongly alkaline; clear smooth boundary.

Btn2—8 to 12 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak coarse and medium subangular blocky; slightly hard, very friable; strong effervescence; very strongly alkaline; clear smooth boundary.

BC—12 to 26 inches; light brownish gray (2.5Y 6/2) loamy sand, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to weak coarse and medium subangular blocky; slightly hard, very friable; strong effervescence; very strongly alkaline; gradual wavy boundary.

C1—26 to 31 inches; light gray (2.5Y 7/2) loamy sand, grayish brown (2.5Y 5/2) moist; moderate coarse prismatic structure parting to moderate coarse and medium subangular blocky; hard, firm; many fine and medium threadlike accumulations of carbonates; violent effervescence; very strongly alkaline; gradual wavy boundary.

C2—31 to 47 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, firm; many fine and medium threadlike accumulations of carbonates; strong effervescence; very strongly alkaline; gradual smooth boundary.

C3—47 to 60 inches; light gray (2.5Y 7/2) loamy sand, grayish brown (2.5Y 5/2) moist; single grain; slightly hard, very friable; very strongly alkaline.

Thickness of the solum ranges from 8 to 32 inches. Reaction ranges from neutral to very strongly alkaline throughout.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is fine sand, loamy sand, or loamy fine sand. The E horizon has hue of 10YR or 2.5Y, value of 4 through 8 (3 through 7 moist), and chroma of 1 through 3. It typically is fine sand, but the range includes loamy sand and loamy fine sand. The Btn horizon has hue of 10YR or 2.5Y, value of 4 or 5 (3 or 4 moist), and chroma of 1 or 2. The horizons having chroma of 2 are mottled. The Btn horizon typically is loamy fine sand, but the range includes loamy sand. The percentage of exchangeable sodium is more than 15 percent, and the sodium adsorption ratio exceeds 13 percent in some parts of the Btn horizon above a depth of 16 inches. The C horizon has hue of 10YR or 2.5Y, value of 5 through 8 (4 through 7 moist), and chroma of 2 or 3. It is fine sand, sand, loamy sand, and loamy fine sand.

Simeon Series

The Simeon series consists of deep, excessively drained, rapidly permeable soils on uplands, breaks, and side slopes along drainageways. These soils formed in sandy alluvium and outwash material. Slopes range from 0 to 30 percent.

Simeon soils commonly are adjacent to Labu, Meadin, O'Neill, Pivot, and Sansarc soils. Labu and Sansarc soils are lower on the landscape and are clayey. Meadin, O'Neill, and Pivot soils have a mollic epipedon. Meadin soils have gravelly coarse sand between depths of 8 and 20 inches. Pivot soils have coarse sand between depths of 20 and 40 inches. O'Neill soils have a finer textured solum and are moderately deep to coarse sand and gravel.

Typical pedon of Simeon loamy sand, 0 to 3 percent slopes, 100 feet north and 100 feet east of the center of sec. 35, T. 32 N., R. 20 W.

A1—0 to 4 inches; dark grayish brown (10YR 4/2) loamy sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; many fine roots; neutral; clear smooth boundary.
A2—4 to 9 inches; dark grayish brown (10YR 4/2) sand; very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; many fine roots; neutral; clear smooth boundary.
AC—9 to 19 inches; brown (10YR 5/3) sand, dark grayish brown (10YR 4/2) moist; single grain; soft, very friable; few gravel pebbles; neutral; clear smooth boundary.
C—19 to 60 inches; very pale brown (10YR 7/3) sand, brown (10YR 5/3) moist; single grain; loose; few gravel pebbles; neutral.

Thickness of the solum ranges from 7 to 20 inches. Reaction ranges from slightly acid to neutral.

The A horizon has value of 3 through 6 (2 through 5 moist) and chroma of 1 or 2. It typically is loamy sand or sand, but the range includes loamy fine sand and fine sand. The AC horizon has value of 4 through 7 (4 through 6 moist) and chroma of 2 or 3. Texture is loamy sand, sand, and coarse sand. The C horizon has value of 6 through 8 (5 through 7 moist) and chroma of 2 through 4. The C horizon typically is coarse sand, loamy coarse sand, or sand, but the range includes loamy sand with more than 35 percent medium and coarse sand. The gravel content in the C horizon ranges up to 15 percent by volume.

Tassel Series

The Tassel series consists of shallow, well drained and somewhat excessively drained, moderately rapidly permeable soils on uplands. These soils formed in material weathered from calcareous sandstone. Slopes range from 3 to 60 percent.

The Tassel soils in Rock County are in a more humid climate than is typical for the Tassel series. This difference, however, does not affect the use or behavior of these soils.

Tassel soils are adjacent to Brunswick, Labu, Meadin, O'Neill, Sansarc, Simeon, and Valentine soils. Brunswick soils are on slightly lower positions and have weathered sandstone at a depth of 20 to 40 inches. Labu soils are on lower steep positions and are moderately deep to bedded shale. Meadin and O'Neill soils commonly are at higher positions. Meadin soils have gravelly coarse sand at depths between 8 and 20 inches. O'Neill soils have gravelly coarse sand at depths between 20 and 40 inches. Sansarc soils are on lower, steeper landscapes and are shallow to bedded shale. Simeon and Valentine soils are on hummocky or level areas and have a sandy profile.

Typical pedon of Tassel loamy sand, in an area of Brunswick-Tassel loamy sands, 3 to 11 percent slopes, 1,300 feet north and 400 feet east of the southwest corner of sec. 32, T. 32 N., R. 18 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) loamy sand, very dark gray (10YR 3/2) moist; weak fine granular structure; very friable; soft, few small soft sandstone rock fragments; strong effervescence; mildly alkaline; clear smooth boundary.
C—6 to 12 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure; very friable, soft; many small and medium soft sandstone rock fragments; violent effervescence; moderately alkaline; gradual wavy boundary.
Cr—12 to 60 inches; white (2.5Y 8/2) partially consolidated soft sandstone, light gray (2.5Y 7/2) moist; firm, slightly hard; violent effervescence; moderately alkaline.

Depth to the sandstone bedrock ranges from 6 to 20 inches. Reaction is mildly or moderately alkaline. In some pedons, the carbonates may be at the surface. In other pedons, an AC horizon is present.

The A horizon has value of 4 through 7 (3 through 5 moist) and chroma of 2 or 3. It dominantly is loamy sand, but the range includes fine sandy loam, sandy loam, and loamy fine sand. The A horizon ranges from 3 to 9 inches in thickness. The C horizon has hue of 10YR or 2.5Y, value of 5 through 8 (4 through 7 moist), and chroma of 2 or 3. It dominantly is fine sandy loam, but the range includes loamy fine sand with fragments of sandstone. The Cr horizon is weathered sandstone that is easily dug with a spade. It has similar colors to those of the C horizon. It crushes to fine sand, loamy fine sand, or loamy sand.

Tryon Series

The Tryon series consists of deep, poorly drained and very poorly drained, rapidly permeable soils that formed in wind- and water-deposited sands (fig. 21). These soils are on valley floors, around lakes, and on bottom lands along streams in the sandhills. Slopes range from 0 to 2 percent.

Tryon soils are similar to Loup soils and commonly are adjacent to Els, Elsmere, Ipage, Marlake, and Valentine soils. Loup soils have a mollic epipedon and are on similar landscape positions. Els and Elsmere soils are higher on the landscape and are somewhat poorly drained. Ipage soils are higher on the landscape and are moderately well drained. Marlake soils are lower on the landscape and are wet for longer periods. Valentine soils are on the steeper hummocky topography and are excessively drained.

Typical pedon of Tryon loamy fine sand, 0 to 2 percent slopes, 1,500 feet south and 1,100 feet west of the northeast corner of sec. 1, T. 27 N., R. 19 W.

Figure 21.—Profile of Tryon loamy fine sand. This soil has a thin surface layer. The water table is at a depth of about 30 inches. The scale is in feet.

A—0 to 5 inches; dark gray (10YR 4/1) loamy fine sand, black (10YR 2/1) moist; weak fine granular; soft, very friable; many fine and very fine roots; medium acid; clear wavy boundary.

AC—5 to 10 inches; light brownish gray (10YR 6/2) loamy sand; grayish brown (10YR 5/2) moist; few faint dark grayish brown (10YR 4/2) mottles; single grain; loose; common fine roots; neutral; gradual wavy boundary.

C1—10 to 23 inches; light gray (10YR 7/1) sand, light brownish gray (10YR 6/2) moist; common medium distinct strong brown (7.5YR 5/6) mottles; single grain; loose; medium acid; gradual wavy boundary.

C2—23 to 26 inches; grayish brown (2.5Y 5/2) fine sand, very dark gray (10YR 3/1) moist; few medium distinct dark brown (7.5YR 4/4) mottles; single grain; slightly hard, very friable; medium acid; gradual wavy boundary.

Cg1—26 to 36 inches; gray (5Y 6/1) sand, olive gray (5Y 5/2) moist; single grain; soft, loose; neutral; gradual wavy boundary.

Cg2—36 to 60 inches; light gray (5Y 7/1) sand, light olive gray (5Y 6/2) moist; single grain; slightly hard, loose; neutral.

Thickness of the solum ranges from 3 to 15 inches. The pedons contain few to many, fine to coarse, faint to prominent reddish brown, strong brown, or yellowish brown mottles. Some pedons contain carbonates near the surface.

The A horizon has value of 3 through 5 (2 or 3 moist) and chroma of 1 or 2. It is loamy fine sand, fine sand, and loamy sand. Reaction is medium acid through moderately alkaline. The AC horizon has hue of 10YR or 2.5Y, value of 5 through 7 (4 or 5 moist), and chroma of 1 or 2. It is fine sand or loamy sand. The C horizon has hue of 10YR through 5Y, value of 5 through 8 (4 through 7 moist), and chroma of 1 through 3. It is fine sand, sand, or loamy sand and is slightly acid through mildly alkaline. Some pedons have buried layers of loamy fine sand 1 to 8 inches thick between depths of 10 and 40 inches. Below a depth of 40 inches, thicker layers of finer textured material are common.

Valentine Series

The Valentine series consists of deep, excessively drained, rapidly permeable soils that formed in sandy eolian material on uplands and in sandhills (fig. 22). Slopes range from 0 to 60 percent.

Valentine soils commonly are adjacent to Dunday, Els, Ipage, Pivot, Simeon, and Tryon soils. Dunday and Pivot soils have a mollic epipedon and are on similar positions on the landscape. Pivot soils are moderately deep to sand and gravel. Els, Ipage, and Tryon soils are lower on the landscape than the Valentine soils. In contrast to the Valentine soils, Els soils are somewhat poorly drained,

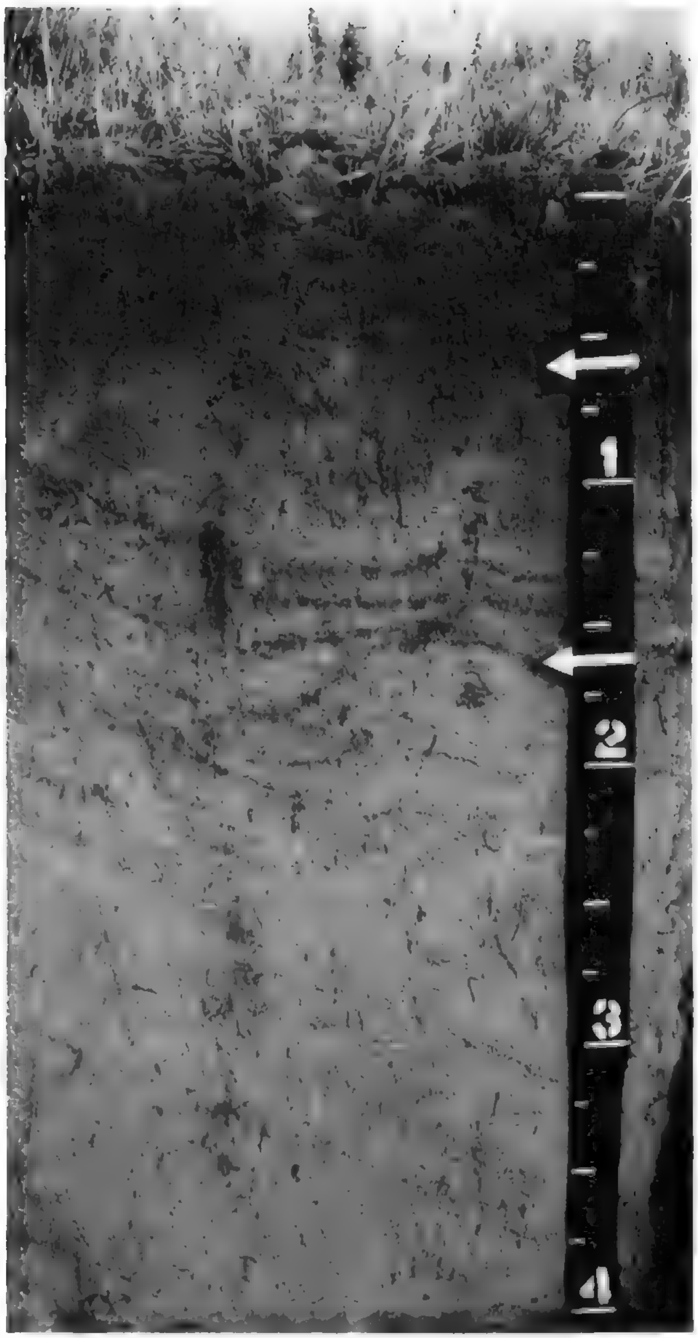

Figure 22.—Profile of Valentine fine sand. This soil is the most common soil in the Nebraska Sandhills. The scale is in feet.

Ipage soils are moderately well drained, and Tryon soils are poorly drained and very poorly drained. In Simeon soils, more than 35 percent of the volume is medium and coarse sand, and as much as 15 percent is gravel.

Typical pedon of Valentine fine sand, rolling, 600 feet south and 600 feet east of the center of sec. 1, T. 27 N., R. 19 W.

A—0 to 4 inches; grayish brown (10YR 5/2) fine sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure parting to single grain; loose; many fine and very fine roots; medium acid; clear wavy boundary.

AC—4 to 10 inches; brown (10YR 5/3) fine sand, dark grayish brown (10YR 4/2) moist; single grain; loose; common very fine and fine roots; medium acid; clear wavy boundary.

C—10 to 62 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; single grain; loose; slightly acid; few fine and very fine roots.

The solum ranges from 3 to 17 inches in thickness. The soil is medium acid to neutral throughout. Some pedons do not have an AC horizon.

The A horizon has value of 4 through 6 (3 through 5 moist) and chroma of 2. The texture dominantly is fine sand, but the range includes loamy sand, loamy fine sand, and sand. The AC horizon has value of 5 through 7 (4 through 6 moist) and chroma of 2 or 3. The C horizon has value of 6 or 7 (5 through 6 moist) and chroma of 2 through 4. The AC and C horizons are similar in texture to the A horizon. All horizons are less than 35 percent medium and coarse sand.

Vetal Series

The Vetal series consists of deep, well drained, moderately rapidly permeable soils on upland swales and alluvial fans. These soils formed in loamy and sandy alluvium. Slopes range from 1 to 3 percent.

Vetal soils are similar to O'Neill soils and commonly are adjacent to Ord, Pivot, and Wewela soils. O'Neill soils have a mollic epipedon less than 20 inches thick. Ord soils are somewhat poorly drained and occur lower in the landscape. Pivot soils are sandy throughout and have a mollic epipedon less than 20 inches thick. Wewela soils have bedded shale at a depth of 20 to 40 inches.

Typical pedon of Vetal loam, 1 to 3 percent slopes, 1,200 feet south and 200 feet east of the northwest corner of sec. 21, T. 32 N., R. 17 W.

Ap—0 to 6 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak fine granular structure; hard, very friable; medium acid; abrupt smooth boundary.

A1—6 to 11 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak medium and coarse subangular blocky structure parting to weak fine granular; hard, very friable; medium acid; clear smooth boundary.

A2—11 to 22 inches; dark grayish brown (10YR 4/2) loam, black (10YR 2/1) moist; weak coarse and medium prismatic structure parting to weak medium and coarse subangular blocky; hard, very friable; medium acid; clear smooth boundary.

AC1—22 to 28 inches; dark grayish brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, very friable; medium acid; clear smooth boundary.

AC2—28 to 42 inches; grayish brown (10YR 5/2) loamy sand, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to single grain; loose; medium acid; clear smooth boundary.

C—42 to 60 inches; light gray (10YR 7/2) sand, grayish brown (10YR 5/2) moist; single grain; loose; medium acid.

The solum thickness ranges from 24 to 60 inches. The mollic epipedon ranges from 20 to 50 inches in thickness and extends into the AC horizon of most pedons. Typically, free carbonates do not occur throughout the profile, but in some pedons, they do occur below a depth of 30 inches. Reaction is medium acid to neutral.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It typically is loam but is sandy loam, fine sandy loam, and loamy fine sand in some pedons. The AC horizon has value of 4 through 6 (3 or 4 moist) and chroma of 1 through 3. It is sandy loam, loamy sand, or fine sandy loam. The C horizon has value of 5 through 7 (4 or 5 moist) and chroma of 2 or 3. It typically is sand but is fine sand and coarse sand in some pedons.

Wewela Series

The Wewela series consists of moderately deep, well drained soils on uplands. Wewela soils formed in loamy, windblown material over clayey material weathered from shale. Permeability is moderate in the loamy material and slow in the underlying clayey material. Slopes range from 2 to 6 percent.

Wewela soils are adjacent to Brunswick, Valentine, and Vetal soils. Brunswick, Valentine, and Vetal soils do not have shale within a depth of 40 inches. Brunswick and Vetal soils occur higher on the landscape. Valentine soils do not have a mollic epipedon and are sandy to a depth of more than 40 inches.

Typical pedon of Wewela fine sandy loam, 2 to 6 percent slopes, 1,200 feet east and 50 feet north of the center of sec. 17, T. 32 N., R. 17 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable; slightly acid; abrupt smooth boundary.

Bt1—7 to 13 inches; dark grayish brown (10YR 4/2) sandy clay loam, very dark grayish brown (2.5Y 3/2) moist; weak coarse and medium subangular blocky structure; slightly hard, very friable; slightly acid; clear smooth boundary.

Bt2—13 to 18 inches; yellowish brown (10YR 5/4) sandy clay loam, olive brown (2.5Y 4/4) moist; weak medium and coarse prismatic structure parting to weak medium and fine subangular blocky; slightly hard, friable; coatings of dark colored A horizon material on sides of ped faces; slightly acid; gradual wavy boundary.

2BC—18 to 24 inches; light yellowish brown (2.5Y 6/4) clay, light olive brown (2.5Y 5/4) moist; moderate coarse prismatic structure parting to moderate coarse and medium subangular blocky; hard, firm; tonguing of A horizon material; slightly acid; gradual smooth boundary.

2C1—24 to 36 inches; light yellowish brown (2.5Y 6/4) shaly clay, light olive brown (2.5Y 5/6) moist; massive; hard, firm; neutral; gradual smooth boundary.

2Cr—36 to 60 inches; light yellowish brown (2.5Y 6/4) bedded shale, light olive brown (2.5Y 5/6) moist; massive with platy fragments; hard, firm; many very fine gypsum crystals; slight effervescence on surface of shale plates; neutral.

The solum thickness ranges from 14 to 33 inches. Thickness of the mollic epipedon ranges from 7 to 13 inches. Depth to free carbonates ranges from 18 to 36 inches. Depth to bedded shale ranges from 22 to 40 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is fine sandy loam, loam, or loamy fine sand. It is slightly acid or neutral. The Bt horizon has hue of 10YR or 2.5Y, value of 4 through 6 (3 through 5 moist), and chroma of 2 through 4. It is sandy clay loam or clay loam that is slightly acid or neutral. The 2C or Cr horizons have hue of 10YR or 2.5Y, value of 5 or 6 (4 through 6 moist), and chroma of 2 through 6. Clay or shaly clay is in the 2C horizon, and bedded shale is in the 2Cr horizon. Segregated lime is common. Reaction is neutral through moderately alkaline.

Formation of the Soils

Soil is produced by soil-forming processes acting on material deposited or accumulated by geologic agencies. Characteristics of a soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material accumulated and has existed since accumulation, (3) the plant and animal life on or in the soil since the beginning or its formation, (4) the relief or lay of the land, and (5) the length of time the processes of soil formation have acted on the soil.

Climate and plant and animal life, especially plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rock and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed to change the parent material into a soil profile. The length of time required for the development of distinct horizons depends on the other factors involved.

The factors of soil formation are closely interrelated in their effects on the soil. Few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent Material

Parent material is the unconsolidated earth material from which a soil forms. It is largely responsible for the chemical and mineralogical composition of the soil. The soils of Rock County formed in materials transported by wind and water and in material weathered from the underlying geologic formation.

The Pierre Shale is the oldest material exposed in Rock County. It is on side slopes along the Niobrara River and its tributaries. Most of the Pierre Shale is black to brown clayey shale that contains layers of bentonite, limestone, and chalky shale. The moderately deep Labu soils and the shallow Sansarc soils formed in residuum of this material. In some places, a thin layer of loamy eolian material mantles the Pierre Shale. Wewela soils formed in this material.

The Ogallala Formation overlies the Pierre Shale. This formation is exposed on slopes along tributaries of the Niobrara River. The Ogallala Formation consists largely of siltstone, sandstone, and fine-grained sand. Consolidation of the sediments varies from packed to cemented. Some are extremely calcareous. Ogallala sediments range in texture from fine sand to sandy clay loam. Much of this material has a thin cover of eolian sand or loess. The moderately deep Brunswick soils formed in residuum of weakly cemented sandstone. The shallow Tassel soils formed in material weathered from bedded sandstone.

Quaternary deposits consisting of sand and gravel rest upon the Ogallala Formation. The sand and gravel was deposited by streamflow during the Pleistocene age. South of U.S. Highway 20, the Quaternary deposits are buried under a thick layer of sandy and loamy alluvium. North of U.S. Highway 20, the deposits are covered by thin layers of eolian sands and silts and by sandy or loamy alluvium. Soils formed in these materials are those of the Jansen, Meadin, O'Neill, Pivot, and Simeon series.

Wind-deposited sand is the most extensive of the soil-forming materials in the county. The sand is of mixed mineralogy, but quartz and feldspar are the principal minerals. Thickness of the sand ranges from a few inches to several hundred feet. In places, the wind has sorted out the fine soil particles and left mostly fine sand in the form of dunes. Valentine soils formed in coarse eolian sand in the sandhills and are mostly gently rolling to hilly. Dunday soils formed in sandy and loamy eolian material. Boelus and Libory soils formed in eolian sand that overlies loamy sediments.

There are no extensive loess deposits in Rock County. In most places, the loess occurs only as a thin layer and generally overlies Pleistocene sands and gravels, Ogallala sediments, or alluvium. The underlying material of Boelus and Libory soils formed in these loamy sediments.

Alluvium, or water-deposited material, consists of clay, silt, sand, and gravel washed from other areas onto bottom lands and stream terraces. The deposits in Rock County range in thickness from a few feet to 25 feet or more. Soil formation is slight in the alluvial sediments, and the texture of the soil is closely related to the texture of its parent material.

Soils on the bottom lands in the subirrigated valleys south of the Elkhorn River formed mostly in sandy alluvium. Large areas are underlain at slight depths by ground water, which keeps the underlying material continually wet and which, in places, periodically rises

high enough to waterlog the entire soil profile. Examples of soils that formed in sandy alluvium are the somewhat poorly drained Elsmere and Els soils, the poorly or very poorly drained Tryon and Loup soils, and the very poorly drained Marlake soils. The somewhat poorly drained Ord soils formed in loamy alluvium or in loamy alluvium over sandy alluvium, and the somewhat poorly drained Selia soils formed in loamy and sandy alluvium that is high in sodium. In some places, the sandy alluvium has been reworked by the wind. The moderately well drained Ipage soils formed in this material.

The most recent alluvium is on bottom lands along drainageways that are subject to occasional flooding. The poorly drained Barney soils and the somewhat poorly drained Boel soils formed in stratified sandy alluvium.

Climate

Rock County's climate is continental and subhumid. The area has wide seasonal variations in temperature and moisture. The mean annual temperature is about 48 degrees F, and the average annual rainfall is about 22 inches. The average growing season is about 134 days.

Climate directly affects soil formation through rainfall, changes in temperature, and the effects of wind. As rainwater moves through the soil, it carries nutrients, clay, and organic matter from the surface horizon to the subsoil or underlying material. As soils develop, precipitation infiltrating the soil leaches free lime from the profiles. Soil materials are also shifted, sorted, and reworked by running water. Temperature and moisture affect the speed of chemical weathering. Alternate freezing and thawing and wetting and drying speed the chemical and mechanical weathering processes and also improve the physical condition of the soil by loosening and mixing the material.

Wind transfers soil material from one place to another. The extensive deposits of eolian sand in Rock County show the importance of wind as an agent in the deposition of soil material. The hummocky topography of the Valentine soils can be attributed to wind activity. As wind mixes and sorts the surface layer, it causes changes in physical properties of the soil. Hot wind in the summer has a drying effect on soils.

Climate affects soils indirectly by determining the amount and kind of vegetation and animal life that is sustained. Activity of animals and other organisms on and in the soil increases when temperature and moisture are favorable. These activities promote plant decomposition, which leads to the accumulation of organic matter and the darkening of the surface layer.

Plant and Animal Life

When the weathering and deposition processes slow down, grasses and other plants take root. As soon as vegetation is established, many kinds of animals and organisms inhabit the soil material to make use of the food provided by the plants. Plants and animals live on or in the soil and influence its physical and chemical properties through the organic matter they provide. The other soil forming factors affect the kind and amounts of vegetation and animal life that live on any given soil.

The soils of Rock County formed under mid and tall grasses. Grasses provide organic matter as the plants and their roots decompose. The fibrous roots of grasses penetrate the soil to a depth of several feet and improve porosity and structure of the soil. Plant roots take minerals from the lower part of the soil, and these nutrients add fertility to the soil as the plants decay. Plants keep the soil porous and open to air and water movement, thus encouraging the activity of bacteria, earthworms, and burrowing animals.

Micro-organisms break down dead roots and undecomposed organic matter to produce humus and other mineral nutrients that are available to living plants. These micro-organisms are more active in the well drained soils than in the wetter, colder, and more poorly aerated soils. Insects, earthworms, and small burrowing animals stir the soil and mix it with fresh nutrients, thus hastening the formation of organic matter. Since some bacteria take nitrogen from the air and use it for their own growth, this nitrogen is available for use by plants when the bacteria die.

Man greatly affects plant and animal life by his management of the soil. Man's activity will affect the direction and rate of soil formation in the future.

Relief

Relief, or lay of the land, influences soil formation through its effect on runoff, drainage, and erosion. Relief controls the movement of water on the surface. The degree of slope, the shape of the surface, and other features of relief affect each soil that develops. Relief influences the content of moisture in soil and the rate of soil erosion. For example, loamy or clayey soils on steep slopes have a thin surface layer and indistinct horizons. The steep slopes cause rapid runoff, so that only a small amount of water enters the soil. Plants grow slowly, and soil formation proceeds slowly. If too much runoff occurs, erosion removes the surface layer almost as fast as it forms.

In the sandhills, little or no runoff occurs because of the rapid rate of water intake. The soils are excessively drained, and horizons are weakly formed and indistinct. The coarse sandy material is highly resistant to chemical weathering.

The nearly level and gently sloping soils normally are better developed and have more distinct horizons than do similar soils on steeper slopes. They absorb more moisture and water percolates more deeply into the profile. Low and flat topography means that the soil receives extra moisture. The extra moisture is reflected

in a thicker, dark surface layer, greater horizon development, and more leaching of lime. Normally, as the slope increases, the thickness of the soil profile decreases.

Soils on bottom lands and stream terraces have very little relief. Some bottom land soils have a high water table that affects decay of organic matter, soil temperature, and alkalinity. Other bottom land soils are subject to flooding and receive continuous deposition of sediment.

Time

Time is required for soil formation. The length of time needed for a soil to form depends on the influence of the other four soil-forming processes, especially that of the parent material. Soils that have been in place only a short time show little or no horizon development. Soils that have been in place for a long time have well-expressed horizons. Mature soils are believed to have reached an equilibrium with their environment. If land use, irrigation, or some other factors change the environment, the soil establishes a new equilibrium to meet the new environment.

Soils that form in residuum develop more slowly than soils that form in other parent material. The weathering of the residuum and the formation of soil take place at the same time, but the process is very slow. The soils that formed in the Pierre Shale and Ogallala sediments are the oldest and have been in place long enough for mature genetic profiles to have developed. The alluvium and eolian material deposited on the Pleistocene sands and gravels on the Holt Table are among the older parent materials in the county. Soils that formed in these materials have been in place long enough for genetic profiles to have developed and for horizons to have accumulated some thickness. Jansen and O'Neill soils are mature soils that are developing subsoil horizons.

The eolian sands and alluvium have not been in place long enough for mature soils to develop. Soils in these deposits are immature and show little or no subsoil development because of the brief time their parent materials have been in place. Examples of young upland soils formed in eolian deposits are Ipage, Simeon, and Valentine soils, which have little horizon development. In allvuial areas subject to flooding, deposition is still occurring. Barney and Boel soils are examples of bottom land soils formed in alluvium. These are some of the youngest soils in the county.

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Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is exposed at the surface by erosion.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catsteps. Very small, irregular terraces on steep hillsides, especially in pasture, formed by the trampling of cattle or the slippage of saturated soil.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth, soil. The total thickness of soil material over bedrock. In this soil survey the classes of soil depths are (1) deep, more than 40 inches; (2) moderately deep, 20 to 40 inches; (3) shallow, 10 to 20 inches; and (4) very shallow, 0 to 10 inches.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from

seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and

biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter, soil. The organic fraction of the soil. It includes plant and animal residues at various stages of decomposition, cells and tissues of soil organisms, and substances synthesized by the soil population. It is commonly determined as those organic materials that accompany the soil material when it is put through a 2-millimeter sieve. In this soil survey the ratings for organic matter content are (1) moderate, 2.0 to 4.0 percent; (2) moderately low, 1.0 to 2.0 percent; (3) low, 0.5 to 1.0 percent; and (4) very low, less than 0.5 percent.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor filter (in tables). Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of

species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey the classes of slope are:

	Percent
Nearly level	0 to 2
Nearly level and very gently sloping	0 to 3
Very gently sloping	1 to 3
Gently sloping	2 to 6
Strongly sloping	6 to 11
Nearly level to strongly sloping	0 to 9
Gently sloping to strongly sloping	3 to 9 and 3 to 11
Moderately steep, rolling	11 to 17
Steep, hilly	17 to 30
Very steep	more than 30

Slow intake (in tables). The slow movement of water into the soil.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of Na^{+} to $Ca^{++} + Mg^{++}$. The degrees of sodicity are—

	SAR
Slight	less than 13:1
Moderate	13-30:1
Strong	more than 30:1

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stratified. Arranged in strata or layers. The term refers to geologic material. Layers in soil that result from the processes of soil formation are called horizons. Those inherited from the parent material are called strata.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsurface layer. Technically, any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and E horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-80 at Newport, Nebraska]

Month	Temperature: Average daily maximum	Temperature: Average daily minimum	Temperature: Average	Temperature: 2 years in 10 will have-- Maximum temperature higher than--	Temperature: 2 years in 10 will have-- Minimum temperature lower than--	Temperature: Average number of growing degree days[1]	Precipitation: Average	Precipitation: 2 years in 10 will have-- Less than--	Precipitation: 2 years in 10 will have-- More than--	Precipitation: Average number of days with 0.10 inch or more	Precipitation: Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	30.0	7.4	18.7	61	-22	0	0.43	0.15	0.66	2	5.1
February---	37.0	13.9	25.5	72	-18	11	.77	.22	1.21	2	7.6
March------	44.5	21.8	33.2	81	-9	23	1.36	.48	2.09	3	9.3
April------	60.1	35.3	47.7	89	13	74	2.35	1.21	3.33	5	3.1
May--------	71.5	46.1	58.8	94	25	286	3.68	1.80	5.30	7	.1
June-------	81.2	55.7	68.5	102	39	555	3.74	2.04	5.23	7	.0
July-------	88.8	61.3	75.1	105	46	778	3.25	1.46	4.77	6	.0
August-----	86.9	59.2	73.1	103	43	716	1.95	.94	2.81	5	.0
September--	76.6	48.9	62.8	100	29	391	2.11	.67	3.28	5	.1
October----	66.0	37.4	51.7	92	17	155	1.29	.33	2.06	3	2.3
November---	47.7	23.6	35.7	79	-4	7	.86	.15	1.39	2	6.4
December---	35.9	13.7	24.8	66	-17	0	.63	.15	1.00	2	7.8
Year------	60.5	35.4	48.0	101	-23	2,996	22.42	17.33	27.29	49	41.8

[1] A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-80 at Newport, Nebraska]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	May 3	May 12	May 20
2 years in 10 later than--	April 27	May 6	May 15
5 years in 10 later than--	April 16	April 26	May 6
First freezing temperature in fall:			
1 year in 10 earlier than--	October 7	September 28	September 18
2 years in 10 earlier than--	October 12	October 3	September 23
5 years in 10 earlier than--	October 22	October 13	October 3

TABLE 3.--GROWING SEASON

[Recorded in the period 1951-80 at Newport, Nebraska]

Probability	Length of growing season if daily temperature is--		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	168	147	125
8 years in 10	175	154	134
5 years in 10	189	169	149
2 years in 10	202	183	164
1 year in 10	209	191	173

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Ba	Barney-Boel complex, channeled	3,060	0.5
Bm	Boel loamy fine sand, 0 to 2 percent slopes	690	0.1
BpB	Boelus loamy sand, 0 to 3 percent slopes	5,860	0.9
BrD	Brunswick-Tassel loamy sands, 3 to 11 percent slopes	3,360	0.5
BtF	Brunswick-Tassel fine sandy loams, 11 to 40 percent slopes	760	0.1
DuB	Dunday loamy fine sand, 0 to 3 percent slopes	5,980	0.9
Eo	Els loamy sand, 0 to 2 percent slopes	11,380	1.7
EpB	Els-Ipage complex, 0 to 3 percent slopes	65,690	10.1
ErC	Els-Ipage-Tryon loamy sands, 0 to 6 percent slopes	7,410	1.1
Es	Elsmere loamy fine sand, 0 to 2 percent slopes	16,220	2.5
ExB	Elsmere-Selia loamy fine sands, 0 to 3 percent slopes	2,960	0.5
IgB	Ipage loamy sand, 0 to 3 percent slopes	4,060	0.6
JsB	Jansen loamy sand, 0 to 3 percent slopes	5,030	0.8
LcG	Labu-Sansarc silty clays, 11 to 40 percent slopes	5,400	0.8
LfB	Libory loamy fine sand, 0 to 3 percent slopes	2,210	0.3
Lo	Loup fine sandy loam, 0 to 2 percent slopes	26,110	4.0
Lp	Loup fine sandy loam, wet, 0 to 2 percent slopes	2,890	0.4
Ma	Marlake loamy fine sand, 0 to 1 percent slopes	4,340	0.7
MeB	Meadin sandy loam, 0 to 3 percent slopes	990	0.2
Oe	O'Neill sandy loam, 0 to 2 percent slopes	2,790	0.4
OeC	O'Neill sandy loam, 2 to 6 percent slopes	3,060	0.5
OhD	O'Neill-Meadin sandy loams, 6 to 11 percent slopes	930	0.1
Or	Ord loam, 0 to 2 percent slopes	530	0.1
PtB	Pivot loamy sand, 0 to 3 percent slopes	19,370	3.0
PvD	Pivot-Valentine complex, 0 to 9 percent slopes	7,020	1.1
SkB	Simeon loamy sand, 0 to 3 percent slopes	7,260	1.1
SmD	Simeon-Meadin complex, 0 to 9 percent slopes	3,600	0.6
SvG2	Simeon-Valentine sands, 9 to 60 percent slopes, eroded	12,250	1.9
TdG	Tassel-Valentine-Duda complex, 15 to 70 percent slopes	800	0.1
Tn	Tryon loamy fine sand, 0 to 2 percent slopes	11,050	1.7
To	Tryon loamy fine sand, wet, 0 to 2 percent slopes	5,060	0.8
TpB	Tryon-Els loamy sands, 0 to 3 percent slopes	41,590	6.4
VaB	Valentine fine sand, 0 to 3 percent slopes	2,350	0.4
VaD	Valentine fine sand, 3 to 9 percent slopes	47,170	7.2
VaE	Valentine fine sand, rolling	149,300	23.0
VaG	Valentine fine sand, rolling and hilly	26,270	4.0
VbB	Valentine loamy fine sand, 0 to 3 percent slopes	6,050	0.9
VbD	Valentine loamy fine sand, 3 to 9 percent slopes	38,450	5.9
VdD	Valentine-Boelus fine sands, 0 to 9 percent slopes	3,160	0.5
VfD	Valentine-Els fine sands, 0 to 9 percent slopes	81,860	12.6
VoB	Vetal loam, 1 to 3 percent slopes	1,240	0.2
WeC	Wewela fine sandy loam, 2 to 6 percent slopes	456	0.1
	Water areas more than 40 acres	4,864	0.7
	Total	650,880	100.0

TABLE 5.--LAND CAPABILITY SUBCLASS AND YIELDS PER ACRE OF CROPS

[Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Land capability subclass		Corn		Alfalfa hay	
	N	I	N	I	N	I
			Bu	Bu	Tons	Tons
Ba------------ Barney-Boel	VIw	---	---	---	---	---
Bm------------ Boel	IVw	IVw	30	100	1.8	3.8
BpB----------- Boelus	IIIe	IIIe	40	135	2.9	5.0
BrD----------- Brunswick-Tassel	IVe	IVe	20	90	1.5	3.8
BtF----------- Brunswick-Tassel	VIs	---	---	---	---	---
DuB----------- Dunday	IVe	IIIe	30	130	1.8	4.2
Eo------------ Els	IVw	IVw	20	105	1.5	4.0
EpB----------- Els-Ipage	VIe	IVe	20	110	1.5	4.0
ErC----------- Els-Ipage-Tryon	VIw	---	---	---	---	---
Es------------ Elsmere	IVw	IVw	35	110	2.1	4.2
ExB----------- Elsmere-Selia	VIs	IVs	---	90	---	3.0
IgB----------- Ipage	IVe	IVe	25	125	1.6	4.1
JsB----------- Jansen	IVe	IIIe	26	125	1.6	4.5
LcG----------- Labu-Sansarc	VIe	---	---	---	---	---
LfB----------- Libory	IIIe	IIIe	40	130	3.4	5.2
Lo, Lp-------- Loup	Vw	---	---	---	---	---
Ma------------ Marlake	VIIIw	---	---	---	---	---
MeB----------- Meadin	VIs	IVs	---	100	---	---
Oe------------ O'Neill	IIIe	IIIe	35	130	1.5	4.5

TABLE 5.--LAND CAPABILITY SUBCLASS AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability subclass		Corn		Alfalfa hay	
	N	I	N	I	N	I
			Bu	Bu	Tons	Tons
OeC----------- O'Neill	IVe	IVe	30	128	1.3	4.2
OhD----------- O'Neill- Meadin	VIe	IVe	---	100	---	---
Or------------ Ord	IIw	IIw	45	125	2.5	5.0
PtB----------- Pivot	IVe	IIIe	25	125	1.2	4.0
PvD----------- Pivot- Valentine	VIe	IVe	25	110	1.4	3.8
SkB----------- Simeon	VIs	IVs	---	100	---	2.8
SmD----------- Simeon-Meadin	VIs	---	---	---	---	---
SvG2---------- Simeon- Valentine	VIs	---	---	---	---	---
TdG----------- Tassel- Valentine- Duda	VIIs	---	---	---	---	---
Tn, To-------- Tryon	Vw	---	---	---	---	---
TpB----------- Tryon-Els	Vw	---	---	---	---	---
VaB----------- Valentine	VIe	IVe	---	115	---	3.4
VaD----------- Valentine	VIe	IVe	---	110	---	3.0
VaE----------- Valentine	VIe	---	---	---	---	---
VaG----------- Valentine	VIIe	---	---	---	---	---
VbB----------- Valentine	IVe	IVe	25	125	1.2	3.8
VbD----------- Valentine	VIe	IVe	---	115	---	3.4
VdD----------- Valentine- Boelus	VIe	IVe	---	125	1.8	4.0
VfD----------- Valentine-Els	VIe	IVe	---	110	---	3.2
VoB----------- Vetal	IIe	IIe	45	140	2.5	5.0
WeC----------- Wewela	IVe	IVe	30	115	1.5	4.0

TABLE 6.--RANGELAND PRODUCTIVITY

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Normal	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
Ba*:				
Barney	Wetland	5,300	5,200	5,000
Boel	Subirrigated	5,200	4,900	4,600
Bm Boel	Subirrigated	5,200	4,900	4,600
BpB Boelus	Sandy	3,500	3,300	3,000
BrD*, BtF*:				
Brunswick	Sandy	3,000	2,500	2,200
Tassel	Shallow Limy	1,800	1,600	1,400
DuB Dunday	Sandy	3,300	3,000	2,600
Eo Els	Subirrigated	5,500	5,300	5,000
EpB*:				
Els	Subirrigated	5,500	5,300	5,000
Ipage	Sandy Lowland	3,500	3,200	3,000
ErC*:				
Els	Subirrigated	5,500	5,300	5,000
Ipage	Sandy Lowland	3,500	3,200	3,000
Tryon	Wet Subirrigated	5,800	5,500	5,300
Es Elsmere	Subirrigated	5,500	5,300	5,000
ExB*:				
Elsmere	Subirrigated	5,500	5,300	5,000
Selia	Saline Subirrigated	3,800	3,400	3,000
IgB Ipage	Sandy Lowland	3,500	3,200	3,000
JsB Jansen	Sandy	3,500	3,300	3,000
LcG*:				
Labu	Clayey	3,400	3,000	2,600
Sansarc	Shallow Clay	2,000	1,800	1,500
LfB Libory	Sandy Lowland	3,500	3,200	3,000
Lo Loup	Wet Subirrigated	5,800	5,500	5,300
Lp Loup	Wetland	6,000	5,800	5,500
MeB Meadin	Shallow to Gravel	1,500	1,300	1,100

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable Lb/acre	Normal Lb/acre	Unfavorable Lb/acre
Oe, OeC O'Neill	Sandy	3,500	3,300	3,000
OhD*:				
O'Neill	Sandy	3,500	3,300	3,000
Meadin	Shallow to Gravel	1,500	1,300	1,100
Or Ord	Subirrigated	5,500	5,300	5,000
PtB Pivot	Sandy	3,300	3,000	2,600
PvD*:				
Pivot	Sandy	3,300	3,000	2,600
Valentine	Sands	3,500	3,200	3,000
SkB Simeon	Shallow to Gravel	1,800	1,600	1,200
SmD*:				
Simeon	Shallow to Gravel	1,800	1,600	1,200
Meadin	Shallow to Gravel	1,500	1,300	1,100
SvG2*:				
Simeon	Shallow to Gravel	1,800	1,600	1,200
Valentine	Sands	3,500	3,200	3,000
TdG*:				
Tassel	Shallow Limy	1,800	1,600	1,400
Valentine	Sands	3,500	3,200	3,000
Duda	Savannah	2,400	2,200	2,000
Tn Tryon	Wet Subirrigated	5,800	5,500	5,300
To Tryon	Wetland	6,000	5,800	5,500
TpB*:				
Tryon	Wet Subirrigated	5,800	5,500	5,300
Els	Subirrigated	5,500	5,300	5,000
VaB Valentine	Sandy	3,300	3,000	2,600
VaD, VaE Valentine	Sands	3,500	3,200	3,000
VaG:				
Valentine, rolling part	Sands	3,500	3,200	3,000
Valentine, hilly part	Choppy Sands	3,300	2,600	2,000
VbB Valentine	Sandy	3,300	3,000	2,600
VbD Valentine	Sands	3,500	3,200	3,000
VdD*:				
Valentine	Sands	3,500	3,200	3,000

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Normal	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
VdD*:				
Boelus	Sandy	3,500	3,300	3,000
VfD*:				
Valentine	Sands	3,500	3,200	3,000
Els	Subirrigated	5,500	5,300	5,000
VoB Vetal	Silty	4,000	3,600	3,300
WeC Wewela	Sandy	3,300	3,000	2,600

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Ba*:					
Barney.					
Boel.					
Bm Boel	Redosier dogwood, American plum.	Common chokecherry	Hackberry, green ash, Austrian pine, Russian mulberry, eastern redcedar.	Honeylocust, silver maple, golden willow.	Eastern cottonwood.
BpB Boelus	Lilac, skunkbush sumac, Tatarian honeysuckle.	Siberian peashrub, Manchurian crabapple, eastern redcedar, Russian-olive.	Green ash, ponderosa pine, hackberry, honeylocust.	Siberian elm	---
BrD*:					
Brunswick	---	Eastern redcedar, Rocky Mountain juniper.	Austrian pine, ponderosa pine, jack pine.	---	---
Tassel.					
BtF*:					
Brunswick.					
Tassel.					
DuB Dunday	Skunkbush sumac, Tatarian honeysuckle, lilac.	Eastern redcedar, Manchurian crabapple, Russian-olive, Siberian peashrub.	Ponderosa pine, green ash, hackberry, honeylocust.	Siberian elm	---
Eo Els	Lilac	Tatarian honeysuckle, common chokecherry, Siberian peashrub.	Eastern redcedar, green ash, hackberry, ponderosa pine.	Honeylocust, silver maple, golden willow.	Eastern cottonwood.
EpB*:					
Els	Lilac	Tatarian honeysuckle, common chokecherry, Siberian peashrub.	Eastern redcedar, green ash, hackberry, ponderosa pine.	Honeylocust, silver maple, golden willow.	Eastern cottonwood.
Ipage	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine, Austrian pine, jack pine.	---	---
ErC*:					
Els	Lilac	Tatarian honeysuckle, common chokecherry, Siberian peashrub.	Eastern redcedar, green ash, hackberry, ponderosa pine.	Honeylocust, silver maple, golden willow.	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
ErC*:					
Ipage	Tatarian honeysuckle, lilac, skunkbush sumac.	Eastern redcedar, Manchurian crabapple, Russian-olive, Siberian peashrub.	Ponderosa pine, green ash, honeylocust, hackberry.	Siberian elm	---
Tryon	Redosier dogwood	---	---	Golden willow	Eastern cottonwood.
Es Elsmere	Lilac	Tatarian honeysuckle, common chokecherry, Siberian peashrub.	Eastern redcedar, green ash, hackberry, ponderosa pine.	Honeylocust, silver maple, golden willow.	Eastern cottonwood.
ExB*:					
Elsmere	Lilac	Tatarian honeysuckle, common chokecherry, Siberian peashrub.	Eastern redcedar, green ash, hackberry, ponderosa pine.	Honeylocust, silver maple, golden willow.	Eastern cottonwood.
Selia.					
IgB Ipage	Tatarian honeysuckle, lilac, skunkbush sumac.	Eastern redcedar, Manchurian crabapple, Russian-olive, Siberian peashrub.	Ponderosa pine, green ash, honeylocust, hackberry.	Siberian elm	---
JsB Jansen	Siberian peashrub, Peking cotoneaster, lilac.	Eastern redcedar, Russian-olive, ponderosa pine, Manchurian crabapple, Rocky Mountain juniper, bur oak.	Green ash, Siberian elm, honeylocust.	---	---
LcG*: Labu.					
Sansarc.					
LfB Libory	Tatarian honeysuckle, lilac, skunkbush sumac.	Eastern redcedar, Russian-olive, Manchurian crabapple, Siberian peashrub.	Ponderosa pine, green ash, honeylocust, hackberry.	Siberian elm	---
Lo Loup	Redosier dogwood	---	---	Golden willow	Eastern cottonwood.
Lp. Loup					
Ma. Marlake					
MeB. Meadin					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Oe, OeC: O'Neill	Siberian peashrub, lilac, Peking cotoneaster.	Eastern redcedar, ponderosa pine, Rocky Mountain juniper, Russian-olive, Manchurian crabapple, bur oak.	Siberian elm, honeylocust, green ash.	---	---
OhD*:					
O'Neill	Siberian peashrub, lilac, Peking cotoneaster.	Eastern redcedar, ponderosa pine, Rocky Mountain juniper, Russian-olive, Manchurian crabapple, bur oak.	Siberian elm, honeylocust, green ash.	---	---
Meadin.					
Or: Ord	Redosier dogwood, American plum.	Common chokecherry	Eastern redcedar, ponderosa pine, Russian mulberry, green ash, hackberry, Manchurian crabapple.	Honeylocust, golden willow.	Eastern cottonwood.
PtB: Pivot	Lilac, Tatarian honeysuckle, skunkbush sumac.	Eastern redcedar, Manchurian crabapple, Siberian peashrub, Russian-olive.	Ponderosa pine, green ash, honeylocust, hackberry.	Siberian elm	---
PvD*:					
Pivot	Lilac, Tatarian honeysuckle, skunkbush sumac.	Eastern redcedar, Manchurian crabapple, Siberian peashrub, Russian-olive.	Ponderosa pine, green ash, honeylocust, hackberry.	Siberian elm	---
Valentine	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine, Austrian pine, jack pine.	---	---
SkB. Simeon					
SmD*:					
Simeon.					
Meadin.					
SvG2*:					
Simeon.					
Valentine.					
TdG*:					
Tassel.					
Valentine.					
Duda.					
Tn: Tryon	Redosier dogwood	---	---	Golden willow	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
To. Tryon					
TpB*: Tryon	Redosier dogwood	---	---	Golden willow	Eastern cottonwood.
Els	Lilac	Tatarian honeysuckle, common chokecherry, Siberian peashrub.	Eastern redcedar, green ash, hackberry, ponderosa pine.	Honeylocust, silver maple, golden willow.	Eastern cottonwood.
VaB, VaD, VaE Valentine	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine, Austrian pine, jack pine.	---	---
VaG. Valentine					
VbB Valentine	Lilac, Tatarian honeysuckle, skunkbush sumac.	Eastern redcedar, Russian-olive, Manchurian crabapple, Siberian peashrub.	Hackberry, ponderosa pine, green ash, honeylocust.	Siberian elm	---
VbD Valentine	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine, Austrian pine, jack pine.	---	---
VdD*: Valentine	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine, Austrian pine, jack pine.	---	---
Boelus	Lilac, skunkbush sumac, Tatarian honeysuckle.	Eastern redcedar, Manchurian crabapple, Siberian peashrub, Russian-olive.	Ponderosa pine, honeylocust, green ash, hackberry.	Siberian elm	---
VfD*: Valentine	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine, Austrian pine, jack pine.	---	---
Els	Lilac	Tatarian honeysuckle, common chokecherry, Siberian peashrub.	Eastern redcedar, green ash, hackberry, ponderosa pine.	Honeylocust, silver maple, golden willow.	Eastern cottonwood.
VoB Vetal	Skunkbush sumac, lilac, Tatarian honeysuckle.	Russian-olive, Manchurian crabapple, eastern redcedar, Siberian peashrub.	Ponderosa pine, hackberry, green ash, honeylocust.	Siberian elm	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
WeC---------------- Wewela	Skunkbush sumac, lilac.	Russian-olive, eastern redcedar, Manchurian crabapple, Rocky Mountain juniper, Tatarian honeysuckle, Siberian peashrub.	Green ash, hackberry, honeylocust.	Siberian elm------	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Ba*:					
Barney	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
Boel	Severe: flooding.	Moderate: wetness.	Moderate: wetness, flooding.	Moderate: wetness.	Moderate: wetness, droughty, flooding.
Bm Boel	Severe: flooding.	Moderate: wetness.	Moderate: wetness, flooding.	Moderate: wetness.	Moderate: wetness, droughty, flooding.
BpB Boelus	Slight	Slight	Slight	Slight	Slight.
BrD*:					
Brunswick	Slight	Slight	Severe: slope.	Slight	Moderate: droughty, thin layer.
Tassel	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight	Severe: thin layer.
BtF*:					
Brunswick	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Tassel	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, thin layer.
DuB Dunday	Slight	Slight	Slight	Slight	Moderate: droughty.
Eo Els	Severe: flooding.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
EpB*:					
Els	Severe: flooding.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
Ipage	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: droughty.
ErC*:					
Els	Severe: flooding.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
Ipage	Slight	Slight	Moderate: slope.	Slight	Severe: droughty.
Tryon	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Es------------------- Elsmere	Severe: flooding.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
ExB*:					
Elsmere--------------	Severe: flooding.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
Selia----------------	Severe: flooding, excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Moderate: wetness.	Severe: excess sodium.
IgB------------------ Ipage	Slight----------	Slight----------	Slight----------	Slight----------	Severe: droughty.
JsB------------------ Jansen	Slight----------	Slight----------	Slight----------	Slight----------	Moderate: droughty.
LcG*:					
Labu-----------------	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too clayey, slope.	Severe: slope, too clayey.
Sansarc--------------	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, erodes easily.	Severe: slope, too clayey, thin layer.
LfB------------------ Libory	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
Lo------------------- Loup	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Lp------------------- Loup	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Ma------------------- Marlake	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
MeB------------------ Meadin	Slight----------	Slight----------	Moderate: small stones.	Slight----------	Moderate: droughty.
Oe------------------- O'Neill	Slight----------	Slight----------	Slight----------	Slight----------	Moderate: droughty.
OeC------------------ O'Neill	Slight----------	Slight----------	Moderate: slope.	Slight----------	Moderate: droughty.
OhD*:					
O'Neill--------------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: droughty, slope.
Meadin---------------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: droughty, slope.
Or------------------- Ord	Severe: flooding.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
PtB: Pivot	Slight	Slight	Slight	Slight	Moderate: droughty.
PvD*:					
Pivot	Slight	Slight	Slight	Slight	Moderate: droughty.
Valentine	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Moderate: droughty.
SkB: Simeon	Slight	Slight	Slight	Slight	Moderate: droughty.
SmD*:					
Simeon	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
Meadin	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: droughty.
SvG2*:					
Simeon	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Severe: slope.
Valentine	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.	Severe: slope.
TdG*:					
Tassel	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, thin layer.
Valentine	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Duda	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Tn: Tryon	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
To: Tryon	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
TpB*:					
Tryon	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Els	Severe: flooding.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
VaB: Valentine	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty.
VaD: Valentine	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Moderate: droughty.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
VaE------------------- Valentine	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Moderate: droughty, slope.
VaG------------------- Valentine	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.	Severe: slope.
VbB------------------- Valentine	Slight----------	Slight----------	Slight----------	Slight----------	Moderate: droughty.
VbD------------------- Valentine	Slight----------	Slight----------	Severe: slope.	Slight----------	Moderate: droughty.
VdD*:					
Valentine------------	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Moderate: droughty.
Boelus---------------	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Slight.
VfD*:					
Valentine------------	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Moderate: droughty.
Els------------------	Severe: flooding, too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: wetness, droughty.
VoB------------------- Vetal	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
WeC------------------- Wewela	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, depth to rock, percs slowly.	Slight----------	Moderate: thin layer.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Ba*:												
Barney	Very poor.	Poor	Fair	Poor	Poor	Fair	Good	Good	Poor	Poor	Good	Fair.
Boel	Fair	Fair	Good	Good	Good	Good	Fair	Fair	Fair	Good	Fair	Fair.
Bm Boel	Fair	Fair	Good	Good	Good	Good	Fair	Fair	Fair	Good	Fair	Fair.
BpB Boelus	Fair	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.	Good.
BrD*:												
Brunswick	Poor	Poor	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.	Good.
Tassel	Poor	Poor	Poor	Fair	Fair	Poor	Very poor.	Very poor.	Poor	Fair	Very poor.	Poor.
BtF*:												
Brunswick	Poor	Poor	Good	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.	Good.
Tassel	Very poor.	Very poor.	Poor	Fair	Fair	Poor	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Poor.
DuB Dunday	Fair	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
Eo Els	Poor	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair	Fair.
EpB*:												
Els	Poor	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair	Fair.
Ipage	Poor	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
ErC*:												
Els	Poor	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair	Fair.
Ipage	Poor	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
Tryon	Very poor.	Poor	Fair	Poor	Poor	Fair	Good	Good	Poor	Poor	Good	Fair.
Es Elsmere	Poor	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Poor	Fair	Fair	Fair.
ExB*:												
Elsmere	Poor	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Poor	Fair	Fair	Fair.
Selia	Poor	Poor	Poor	Poor	Poor	Poor	Fair	Fair	Poor	Poor	Fair	Poor.
IgB Ipage	Poor	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
JsB Jansen	Fair	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.	Fair.
LcG*:												
Labu	Poor	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
LcG*: Sansarc	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Fair.
LfB Libory	Fair	Fair	Good	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.	Good.
Lo, Lp Loup	Very poor.	Poor	Fair	Poor	Poor	Fair	Good	Good	Poor	Poor	Good	Fair.
Ma Marlake	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good	Very poor.
MeB Meadin	Poor	Poor	Fair	Poor	Poor	Fair	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.
Oe, OeC O'Neill	Fair	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.	Fair.
OhD*: O'Neill	Poor	Fair	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
Meadin	Very poor.	Poor	Fair	Poor	Poor	Fair	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.
Or Ord	Good	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair	Good.
PtB Pivot	Fair	Fair	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
PvD*: Pivot	Fair	Fair	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
Valentine	Poor	Fair	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
SkB Simeon	Poor	Poor	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.
SmD*: Simeon	Poor	Poor	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.
Meadin	Very poor.	Poor	Fair	Poor	Poor	Fair	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.
SvG2*: Simeon	Poor	Poor	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.
Valentine	Very poor.	Very poor.	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.
TdG*: Tassel	Very poor.	Very poor.	Poor	Fair	Fair	Poor	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Poor.
Valentine	Very poor.	Very poor.	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.
Duda.												
Tn, To Tryon	Very poor.	Poor	Fair	Poor	Poor	Fair	Good	Good	Poor	Poor	Good	Fair.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
TpB*:												
Tryon	Very poor.	Poor	Fair	Poor	Poor	Fair	Good	Good	Poor	Poor	Good	Fair.
Els	Poor	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair	Fair.
VaB, VaD, VaE Valentine	Poor	Fair	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
VaG Valentine	Very poor.	Very poor	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.
VbB Valentine	Fair	Good	Fair	Poor	Fair	Fair	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
VbD Valentine	Poor	Fair	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
VdD*:												
Valentine	Poor	Fair	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
Boelus	Fair	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.
VfD*:												
Valentine	Poor	Fair	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
Els	Poor	Poor	Fair	Fair	Fair	Fair	Fair	Fair	Poor	Fair	Fair	Fair.
VoB Vetal	Fair	Fair	Good	Fair	Very poor.	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Good.
WeC Wewela	Fair	Fair	Good	Fair	Very poor.	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition and does not eliminate the need for onsite investigation]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Ba*:						
Barney	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: wetness, flooding.
Boel	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding.	Moderate: wetness, droughty, flooding.
Bm: Boel	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding.	Moderate: wetness, droughty, flooding.
BpB: Boelus	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
BrD*:						
Brunswick	Severe: cutbanks cave, depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock.	Moderate: slope.	Moderate: frost action, slope, depth to rock.	Moderate: droughty, thin layer.
Tassel	Severe: depth to rock.	Moderate: depth to rock, slope.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock, slope.	Severe: thin layer.
BtF*:						
Brunswick	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Tassel	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, thin layer.
DuB: Dunday	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
Eo: Els	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Moderate: wetness, flooding, frost action.	Moderate: wetness, droughty.
EpB*:						
Els	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Moderate: wetness, flooding, frost action.	Moderate: wetness, droughty.
Ipage	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.	Severe: droughty.
ErC*:						
Els	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Moderate: wetness, flooding, frost action.	Moderate: wetness, droughty.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
ErC*:						
Ipage	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.	Severe: droughty.
Tryon	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.
Es Elsmere	Severe: wetness, cutbanks cave.	Severe: flooding.	Severe: wetness, flooding.	Severe: flooding.	Moderate: wetness, frost action, flooding.	Moderate: wetness, droughty.
ExB*:						
Elsmere	Severe: wetness, cutbanks cave.	Severe: flooding.	Severe: wetness, flooding.	Severe: flooding.	Moderate: wetness, frost action, flooding.	Moderate: wetness, droughty.
Selia	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Moderate: wetness, flooding, frost action.	Severe: excess sodium.
IgB Ipage	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.	Severe: droughty.
JsB Jansen	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Severe: low strength.	Moderate: droughty.
LcG*:						
Labu	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope, too clayey.
Sansarc	Severe: slope, depth to rock.	Severe: slope, shrink-swell.	Severe: slope, shrink-swell, depth to rock.	Severe: slope, shrink-swell.	Severe: slope, shrink-swell, low strength.	Severe: slope, too clayey, thin layer.
LfB Libory	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
Lo Loup	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.
Lp Loup	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding.
Ma Marlake	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
MeB Meadin	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
Oe O'Neill	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.	Moderate: droughty.
OeC O'Neill	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.	Moderate: droughty.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
OhD*:						
O'Neill	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: droughty, slope.
Meadin	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
Or: Ord	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: frost action.	Moderate: wetness.
PtB: Pivot	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
PvD*:						
Pivot	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
Valentine	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
SkB: Simeon	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
SmD*:						
Simeon	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
Meadin	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
SvG2*:						
Simeon	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Valentine	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
TdG*:						
Tassel	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, thin layer.
Valentine	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Duda	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Tn: Tryon	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.
To: Tryon	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding.
TpB*:						
Tryon	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
TpB*:						
Els	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Moderate: wetness, flooding, frost action.	Moderate: wetness, droughty.
VaB Valentine	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
VaD Valentine	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
VaE Valentine	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
VaG Valentine	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
VbB Valentine	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
VbD Valentine	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
VdD*:						
Valentine	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
Boelus	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
VfD*:						
Valentine	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
Els	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Moderate: wetness, flooding, frost action.	Moderate: wetness, droughty.
VoB Vetal	Slight	Slight	Slight	Slight	Moderate: frost action.	Slight.
WeC Wewela	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: slope, shrink-swell.	Severe: low strength, shrink-swell.	Moderate: thin layer.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition and does not eliminate the need for onsite investigation]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ba*:					
Barney	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, wetness.
Boel	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy.
Bm: Boel	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy.
BpB: Boelus	Slight	Moderate: seepage.	Slight	Slight	Good.
BrD*:					
Brunswick	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim.
Tassel	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
BtF*:					
Brunswick	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, slope.
Tassel	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
DuB: Dunday	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Eo: Els	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
EpB*:					
Els	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
Ipage	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
ErC*:					
Els	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
Ipage	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
Tryon	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
Es: Elsmere	Severe: wetness, poor filter.	Severe: wetness, seepage.	Severe: wetness, seepage.	Severe: wetness, seepage.	Poor: too sandy, seepage.
ExB*:					
Elsmere	Severe: wetness, poor filter.	Severe: wetness, seepage.	Severe: wetness, seepage.	Severe: wetness, seepage.	Poor: too sandy, seepage.
Selia	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy, excess sodium.
IgB: Ipage	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
JsB: Jansen	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
LcG*:					
Labu	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, hard to pack.
Sansarc	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Poor: slope, area reclaim, hard to pack.
LfB: Libory	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage.	Fair: too clayey, wetness.
Lo: Loup	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
Lp: Loup	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ma------------------- Marlake	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
MeB------------------ Meadin	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Oe, OeC-------------- O'Neill	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
OhD*:					
O'Neill--------------	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Meadin--------------	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Or------------------- Ord	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy.
PtB------------------ Pivot	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
PvD*:					
Pivot---------------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Valentine-----------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
SkB------------------ Simeon	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
SmD*:					
Simeon--------------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Meadin--------------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
SvG2*:					
Simeon--------------	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
Valentine-----------	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
TdG*:					
Tassel	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
Valentine	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
Duda	Severe: depth to rock, poor filter, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, too sandy, slope.
Tn Tryon	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
To Tryon	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
TpB*:					
Tryon	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
Els	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
VaB, VaD Valentine	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
VaE Valentine	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
VaG Valentine	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
VbB, VbD Valentine	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
VdD*:					
Valentine	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Boelus	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: thin layer.
VfD*:					
Valentine	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
VfD*:					
Els	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
VoB Vetal	Moderate: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
WeC Wewela	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, hard to pack.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition and does not eliminate the need for onsite investigation]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ba*:				
Barney	Poor: wetness.	Probable	Improbable: too sandy.	Poor: thin layer, wetness.
Boel	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
Bm Boel	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
BpB Boelus	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
BrD*:				
Brunswick	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Tassel	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
BtF*:				
Brunswick	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
Tassel	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
DuB Dunday	Good	Probable	Improbable: too sandy.	Poor: thin layer.
Eo Els	Fair: wetness.	Probable	Improbable: too sandy.	Fair: too sandy, small stones.
EpB*:				
Els	Fair: wetness.	Probable	Improbable: too sandy.	Fair: too sandy, small stones.
Ipage	Good	Probable	Improbable: too sandy.	Poor: too sandy.
ErC*:				
Els	Fair: wetness.	Probable	Improbable: too sandy.	Fair: too sandy, small stones.
Ipage	Good	Probable	Improbable: too sandy.	Fair: too sandy.
Tryon	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
Es Elsmere	Fair: wetness.	Probable	Improbable: too sandy.	Poor: area reclaim.
ExB*:				
Elsmere	Fair: wetness.	Probable	Improbable: too sandy.	Poor: area reclaim.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
ExB*:				
Selia	Fair: wetness.	Probable	Improbable: too sandy.	Poor: excess sodium, area reclaim.
IgB Ipage	Good	Probable	Improbable: too sandy.	Fair: too sandy.
JsB Jansen	Good	Probable	Improbable: too sandy.	Poor: area reclaim.
LcG*:				
Labu	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
Sansarc	Poor: slope, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope, too clayey, area reclaim.
LfB Libory	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
Lo Loup	Poor: wetness.	Probable	Improbable: too sandy.	Poor: thin layer, wetness.
Lp Loup	Poor: wetness.	Improbable: thin layer.	Improbable: too sandy.	Poor: thin layer, wetness.
Ma Marlake	Poor: wetness.	Probable	Improbable: too sandy.	Poor: thin layer, wetness.
MeB Meadin	Good	Probable	Probable	Poor: small stones, area reclaim.
Oe, OeC O'Neill	Good	Probable	Probable	Fair: small stones.
OhD*:				
O'Neill	Good	Probable	Probable	Fair: small stones, slope.
Meadin	Good	Probable	Probable	Poor: small stones, area reclaim.
Or Ord	Fair: wetness.	Probable	Improbable: too sandy.	Fair: thin layer.
PtB Pivot	Good	Probable	Probable	Poor: area reclaim.
PvD*:				
Pivot	Good	Probable	Probable	Poor: area reclaim.
Valentine	Good	Probable	Improbable: too sandy.	Poor: area reclaim, too sandy.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
SkB------------------- Simeon	Good	Probable	Improbable: too sandy.	Fair: too sandy, small stones.
SmD*:				
Simeon	Good	Probable	Improbable: too sandy.	Fair: too sandy, small stones.
Meadin	Good	Probable	Probable	Poor: small stones, area reclaim.
SvG2*:				
Simeon	Fair: slope.	Probable	Improbable: too sandy.	Poor: too sandy.
Valentine	Poor: slope.	Probable	Improbable: too sandy.	Poor: area reclaim, too sandy, slope.
TdG*:				
Tassel	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
Valentine	Poor: slope.	Probable	Improbable: too sandy.	Poor: area reclaim, slope.
Duda	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
Tn Tryon	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
To Tryon	Poor: wetness.	Probable	Improbable: too sandy.	Poor: small stones, wetness.
TpB*:				
Tryon	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
Els	Fair: wetness.	Probable	Improbable: too sandy.	Fair: too sandy, small stones.
VaB, VaD, VaE Valentine	Good	Probable	Improbable: too sandy.	Poor: area reclaim, too sandy.
VaG Valentine	Poor: slope.	Probable	Improbable: too sandy.	Poor: area reclaim, too sandy, slope.
VbB, VbD Valentine	Good	Probable	Improbable: too sandy.	Poor: area reclaim.
VdD*:				
Valentine	Good	Probable	Improbable: too sandy.	Poor: area reclaim, too sandy.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
VdD*:				
Boelus	Good	Probable	Probable	Poor: too sandy.
VfD*:				
Valentine	Good	Probable	Improbable: too sandy.	Poor: area reclaim, too sandy.
Els	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
VoB Vetal	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
WeC Wewela	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition and does not eliminate the need for onsite investigation]

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Ba*:						
Barney	Severe: seepage.	Severe: seepage, piping, wetness.	Flooding, cutbanks cave.	Wetness, droughty.	Wetness, too sandy, soil blowing.	Wetness, droughty.
Boel	Severe: seepage.	Severe: seepage, piping, wetness.	Flooding, cutbanks cave.	Wetness, droughty, fast intake.	Wetness, too sandy.	Droughty.
Bm: Boel	Severe: seepage.	Severe: seepage, piping, wetness.	Flooding, cutbanks cave.	Wetness, droughty, fast intake.	Wetness, too sandy.	Droughty.
BpB: Boelus	Moderate: seepage.	Severe: piping.	Deep to water	Fast intake, soil blowing.	Erodes easily, soil blowing.	Erodes easily.
BrD*:						
Brunswick	Severe: seepage.	Severe: piping.	Deep to water	Droughty, fast intake, depth to rock.	Depth to rock, slope, soil blowing.	Droughty, depth to rock.
Tassel	Severe: depth to rock.	Severe: piping.	Deep to water	Fast intake, soil blowing.	Depth to rock, soil blowing.	Depth to rock.
BtF*:						
Brunswick	Severe: seepage, slope.	Severe: piping.	Deep to water	Droughty, depth to rock.	Slope, depth to rock, soil blowing.	Slope, droughty, depth to rock.
Tassel	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Soil blowing, depth to rock, slope.	Slope, depth to rock, soil blowing.	Slope, depth to rock.
DuB: Dunday	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Eo: Els	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty, rooting depth.
EpB*:						
Els	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty, rooting depth.
Ipage	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
ErC*:						
Els	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty, rooting depth.
Ipage	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
ErC*:						
Tryon	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy.	Wetness, droughty.
Es Elsmere	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy, soil blowing.	Droughty.
ExB*:						
Elsmere	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy, soil blowing.	Droughty.
Selia	Severe: seepage.	Severe: seepage, piping, wetness.	Percs slowly, cutbanks cave.	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Excess sodium, droughty, percs slowly.
IgB Ipage	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
JsB Jansen	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
LcG*:						
Labu	Severe: slope.	Severe: hard to pack.	Deep to water	Droughty, slow intake, percs slowly.	Slope, depth to rock, percs slowly.	Slope, droughty, depth to rock.
Sansarc	Severe: depth to rock, slope.	Severe: hard to pack.	Deep to water	Slow intake, droughty, percs slowly.	Slope, depth to rock, percs slowly.	Slope, droughty, erodes easily.
LfB Libory	Severe: seepage.	Severe: piping.	Favorable	Wetness, droughty, fast intake.	Erodes easily, wetness, soil blowing.	Erodes easily, droughty, rooting depth.
Lo Loup	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy, soil blowing.	Wetness, droughty.
Lp Loup	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, cutbanks cave.	Ponding, droughty.	Ponding, too sandy.	Wetness, droughty.
Ma Marlake	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, cutbanks cave.	Ponding, droughty, fast intake.	Ponding, too sandy, soil blowing.	Wetness, droughty.
MeB Meadin	Severe: seepage.	Severe: seepage.	Deep to water	Droughty	Too sandy, soil blowing.	Droughty.
Oe, OeC O'Neill	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, soil blowing, rooting depth.	Too sandy, soil blowing.	Droughty, rooting depth.
OhD*:						
O'Neill	Severe: seepage, slope.	Severe: seepage.	Deep to water	Droughty, soil blowing, rooting depth.	Slope, too sandy, soil blowing.	Slope, droughty, rooting depth.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
OhD*:						
Meadin	Severe: seepage, slope.	Severe: seepage.	Deep to water	Droughty, slope.	Slope, too sandy, soil blowing.	Slope, droughty.
Or: Ord	Severe: seepage.	Severe: seepage, piping, wetness.	Frost action, cutbanks cave.	Wetness	Wetness, too sandy.	Rooting depth.
PtB: Pivot	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
PvD*:						
Pivot	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Valentine	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
SkB: Simeon	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
SmD*:						
Simeon	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Meadin	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, slope.	Too sandy, soil blowing.	Droughty.
SvG2*:						
Simeon	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
Valentine	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
TdG*:						
Tassel	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Fast intake, soil blowing.	Slope, depth to rock, soil blowing.	Slope, depth to rock.
Valentine	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
Duda	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, depth to rock, too sandy.	Slope, droughty, depth to rock.
Tn: Tryon	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy.	Wetness, droughty.
To: Tryon	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, cutbanks cave.	Ponding, droughty, fast intake.	Ponding, too sandy.	Wetness, droughty.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
TpB*:						
Tryon	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy.	Wetness, droughty.
Els	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty, rooting depth.
VaB, VaD Valentine	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
VaE, VaG Valentine	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
VbB, VbD Valentine	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
VdD*:						
Valentine	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Boelus	Severe: seepage.	Severe: thin layer.	Deep to water	Fast intake, soil blowing.	Soil blowing	Rooting depth.
VfD*:						
Valentine	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Els	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty, rooting depth.
VoB Vetal	Severe: seepage.	Severe: piping.	Deep to water	Favorable	Favorable	Favorable.
WeC Wewela	Moderate: depth to rock, slope.	Severe: hard to pack.	Deep to water	Percs slowly, depth to rock.	Depth to rock, soil blowing.	Depth to rock, percs slowly.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Ba*:											
Barney	0-7	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-2, A-4	0	90-100	90-100	60-95	30-70	18-30	NP**-7
	7-17	Stratified loam to sand.	SM, ML	A-2, A-4	0	90-100	90-100	55-80	20-60	---	NP
	17-60	Coarse sand, sand, fine sand.	SP, SM, SP-SM	A-1, A-2, A-3	0	90-100	85-100	30-70	3-15	---	NP
Boel	0-15	Loamy sand	SM, SP	A-2, A-3	0	100	95-100	85-95	0-35	---	NP
	15-60	Sand, loamy sand, coarse sand.	SP, SM	A-2, A-3	0	100	95-100	85-95	0-25	---	NP
Bm: Boel	0-8	Loamy fine sand	SM, SP	A-2, A-3	0	100	95-100	85-95	0-35	---	NP
	8-60	Sand, loamy sand, coarse sand.	SP, SM	A-2, A-3	0	100	95-100	85-95	0-25	---	NP
BpB: Boelus	0-14	Loamy sand	SM, SP-SM	A-2	0	100	100	50-100	10-35	<20	NP
	14-23	Loamy fine sand, loamy sand, sand.	SM, SP-SM	A-2	0	100	100	50-100	10-35	<20	NP
	23-37	Silt loam, loam, very fine sandy loam.	CL	A-4, A-6	0	100	100	90-100	80-100	30-40	8-15
	37-60	Silt loam, loam, very fine sandy loam.	CL	A-4, A-6	0	100	100	90-100	80-100	30-40	8-18
BrD*:											
Brunswick	0-4	Loamy sand	SM	A-4, A-2	0	95-100	95-100	70-85	30-50	---	NP
	4-19	Fine sandy loam, loamy very fine sand, loam.	SM, ML, CL-ML, SM-SC	A-2, A-4	0	95-100	95-100	65-95	30-65	18-35	NP-10
	19-24	Loamy fine sand, fine sand, fine sandy loam.	SM	A-2, A-4	0	95-100	95-100	65-90	20-50	---	NP
	24-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Tassel	0-6	Loamy sand	SM	A-2	0	95-100	90-100	65-95	15-30	---	NP
	6-12	Fine sandy loam, loamy very fine sand, sandy loam.	ML, SM	A-4	0	95-100	90-100	65-95	40-65	<35	NP-7
	12-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
BtF*:											
Brunswick	0-4	Fine sandy loam	SM, SC, ML, CL	A-4	0	95-100	95-100	70-95	40-55	<25	NP-10
	4-19	Fine sandy loam, loamy very fine sand, loam.	SM, ML, CL-ML, SM-SC	A-2, A-4	0	95-100	95-100	65-95	30-65	18-35	NP-10
	19-24	Loamy fine sand, fine sand, fine sandy loam.	SM	A-2, A-4	0	95-100	95-100	65-90	20-50	---	NP
	24-60	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnotes at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
BtF*:											
Tassel----------	0-6	Fine sandy loam	ML, SM	A-4	0	95-100	90-100	75-100	40-65	<35	NP-7
	6-12	Fine sandy loam, loamy very fine sand, sandy loam.	ML, SM	A-4	0	95-100	90-100	65-95	40-65	<35	NP-7
	12-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
DuB-------------- Dunday	0-11	Loamy fine sand	SM, SM-SC	A-2	0	100	100	90-100	13-35	<25	NP-4
	11-60	Fine sand, loamy sand, loamy fine sand.	SM, SP-SM, SM-SC	A-2, A-3	0	100	100	50-95	5-35	<25	NP-4
Eo--------------- Els	0-4	Loamy sand-------	SP-SM, SM	A-2, A-3	0	100	100	70-100	5-35	---	NP
	4-60	Fine sand, loamy fine sand, sand.	SP-SM, SM, SP	A-2, A-3	0	90-100	90-100	70-100	4-30	---	NP
EpB*:											
Els-------------	0-9	Loamy sand-------	SP-SM, SM	A-2, A-3	0	100	100	70-100	5-35	---	NP
	9-60	Fine sand, loamy sand, sand.	SP-SM, SM, SP	A-2, A-3	0	90-100	90-100	70-100	4-30	---	NP
Ipage-----------	0-5	Fine sand--------	SM, SP-SM	A-2, A-3	0	100	100	50-70	5-30	---	NP
	5-60	Fine sand, loamy sand, sand.	SM, SP-SM, SP	A-2, A-3	0	100	95-100	50-95	2-30	---	NP
ErC*:											
Els-------------	0-6	Loamy sand-------	SP-SM, SM	A-2, A-3	0	100	100	70-100	5-35	---	NP
	6-60	Fine sand, loamy sand, sand.	SP-SM, SM, SP	A-2, A-3	0	90-100	90-100	70-100	4-30	---	NP
Ipage-----------	0-8	Loamy sand-------	SM, SP-SM	A-2	0	100	100	50-90	10-35	---	NP
	8-60	Fine sand, loamy sand, sand.	SM, SP-SM, SP	A-2, A-3	0	100	95-100	50-95	2-30	---	NP
Tryon-----------	0-3	Loamy sand-------	SM, SP-SM	A-2	0	100	100	85-100	10-30	---	NP
	3-60	Fine sand, loamy sand, sand.	SP-SM, SM	A-2, A-3	0	100	100	51-90	5-30	---	NP
Es--------------- Elsmere	0-19	Loamy fine sand	SM, SP-SM	A-2, A-3	0	100	100	70-100	5-35	---	NP
	19-60	Sand, loamy fine sand, loamy sand.	SP-SM, SM	A-2, A-3	0	100	100	60-100	5-30	---	NP
ExB*:											
Elsmere---------	0-10	Loamy fine sand	SM, SP-SM	A-2, A-3	0	100	100	70-100	5-35	---	NP
	10-60	Sand, loamy fine sand, loamy sand.	SP-SM, SM	A-2, A-3	0	100	100	60-100	5-30	---	NP
Selia-----------	0-4	Loamy fine sand	SM	A-2, A-4	0	100	100	50-85	15-40	---	NP
	4-26	Loamy fine sand, loamy sand.	SM	A-2, A-4	0	100	100	50-85	15-40	---	NP
	26-60	Fine sand, loamy sand, loam.	SM, SP-SM, CL, ML	A-2, A-3, A-4, A-6	0	100	100	50-90	5-60	<25	NP-11
IgB-------------- Ipage	0-9	Loamy sand-------	SM, SP-SM	A-2	0	100	100	50-90	10-35	---	NP
	9-60	Fine sand, loamy sand, sand.	SM, SP-SM, SP	A-2, A-3	0	100	95-100	50-95	2-30	---	NP

See footnotes at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
JsB-------------- Jansen	0-11	Loamy sand-------	SM, SP-SM	A-2, A-3	0	100	100	70-100	5-35	---	NP
	11-24	Clay loam, loam, sandy clay loam.	CL	A-6, A-7	0	95-100	90-100	80-100	70-80	30-45	10-25
	24-60	Coarse sand, sand, gravelly coarse sand.	SW, SW-SM, SP, SP-SM	A-3, A-1, A-2	0	85-100	45-100	35-65	3-10	---	NP
LcG*:											
Labu------------	0-6	Silty clay-------	CH, MH	A-7	0	100	95-100	90-100	85-100	50-85	20-50
	6-35	Silty clay, clay, shaly clay.	CH, MH	A-7	0	100	95-100	90-100	85-100	50-85	20-50
	35-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Sansarc----------	0-4	Silty clay-------	CH, MH	A-7	0	100	95-100	90-100	75-100	60-90	25-55
	4-18	Shaly clay, very shaly clay, clay.	CH, MH	A-7	0	80-100	75-100	75-100	75-100	60-90	25-55
	18-60	Weathered bedrock	CH, MH	A-7	0	100	100	90-100	80-100	60-90	25-55
LfB-------------- Libory	0-14	Loamy fine sand	SM	A-2, A-4	0	100	100	65-85	15-45	---	NP
	14-24	Loamy fine sand, loamy sand, fine sand.	SM, SP-SM	A-2	0	100	100	55-80	12-35	---	NP
	24-60	Silty clay loam, loam, very fine sandy loam.	CL, CL-ML	A-4, A-6	0	100	100	85-100	60-95	20-40	4-24
Lo--------------- Loup	0-10	Fine sandy loam	SM, SM-SC	A-2	0	100	100	70-95	20-35	<20	NP-6
	10-60	Fine sand, loamy sand, sand.	SP-SM, SM	A-2, A-3	0	100	100	65-100	5-20	---	NP
Lp--------------- Loup	0-19	Fine sandy loam	SM, SM-SC	A-2	0	100	100	70-95	20-35	<20	NP-6
	19-48	Fine sand, loamy sand, loamy fine sand.	SP-SM, SM	A-2, A-3	0	100	100	65-100	5-20	---	NP
	48-60	Fine sandy loam, loam.	SM, ML, SM-SC, CL-ML	A-2, A-4	0	100	100	70-90	30-70	<20	NP-5
Ma--------------- Marlake	0-8	Loamy fine sand	SM	A-2, A-4	0	100	100	50-85	15-50	---	NP
	8-19	Fine sand, loamy sand, loamy fine sand.	SP-SM, SM	A-2, A-4, A-3	0	100	100	50-85	5-50	---	NP
	19-60	Sand, fine sand, loamy fine sand.	SM, SP-SM	A-2, A-3	0	100	100	50-80	5-35	---	NP
MeB-------------- Meadin	0-8	Sandy loam-------	SM, ML, CL-ML, SM-SC	A-2, A-4	0	85-100	75-95	45-80	25-55	<20	NP-5
	8-24	Coarse sand, very gravelly loamy sand, gravelly sandy loam.	SM, SP-SM, GM, GP-GM	A-3, A-2	0	50-90	50-90	50-65	5-35	---	NP
	24-60	Gravelly coarse sand, very gravelly coarse sand, gravelly sand.	SP-SM, SP, GP-GM, GP	A-1	0	40-80	30-70	15-50	1-10	---	NP

See footnotes at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Oe, OeC---------- O'Neill	0-7	Sandy loam-------	SM, ML, CL, SM-SC	A-4	0	95-100	95-100	70-85	35-55	<25	NP-10
	7-32	Fine sandy loam, sandy loam.	SC, SM-SC	A-2, A-4	0	95-100	95-100	60-75	30-50	<30	4-10
	32-60	Stratified sand to gravelly sand.	SP, SP-SM	A-1, A-2, A-3	0	70-100	50-90	25-60	0-5	---	NP
OhD*:											
O'Neill---------	0-14	Sandy loam-------	SM, ML, CL, SM-SC	A-4	0	95-100	95-100	70-85	35-55	<25	NP-10
	14-36	Fine sandy loam, sandy loam.	SC, SM-SC	A-2, A-4	0	95-100	95-100	60-75	30-50	<30	4-10
	36-60	Stratified sand to gravelly sand.	SP, SP-SM	A-1, A-2, A-3	0	70-100	50-90	25-60	0-5	---	NP
Meadin----------	0-16	Sandy loam-------	SM, ML, CL-ML, SM-SC	A-2, A-4	0	85-100	75-95	45-80	25-55	<20	NP-5
	16-60	Gravelly coarse sand, coarse sand, loamy sand.	SP-SM, SP, GP-GM, GP	A-1	0	40-80	30-70	15-50	1-10	---	NP
Or--------------- Ord	0-18	Loam-------------	ML	A-4	0	100	100	95-100	95-100	25-35	2-8
	18-21	Fine sandy loam, loamy fine sand, sandy loam.	SM, ML	A-2, A-4	0	95-100	95-100	70-100	30-85	20-35	NP-10
	21-60	Stratified sand to loamy fine sand.	SM, SP-SM, SM-SC	A-2,A-3	0	95-100	95-100	50-100	5-30	<20	NP-5
PtB-------------- Pivot	0-13	Loamy sand-------	SM, SP-SM	A-2	0	100	100	50-90	10-35	<20	NP
	13-27	Loamy sand, loamy coarse sand, sand.	SM, SW-SM, SP-SM	A-2, A-3	0	100	95-100	50-85	5-30	---	NP
	27-60	Loamy coarse sand, coarse sand, sand.	SM, SW-SM, SP-SM, SP	A-2, A-3	0	95-100	95-100	50-70	3-15	---	NP
PvD*:											
Pivot-----------	0-11	Loamy sand-------	SM, SP-SM	A-2	0	100	100	50-90	10-35	<20	NP
	11-24	Loamy sand, loamy coarse sand, sand.	SM, SW-SM, SP-SM	A-2, A-3	0	100	95-100	50-85	5-30	---	NP
	24-60	Loamy coarse sand, coarse sand, sand.	SM, SW-SM, SP-SM, SP	A-2, A-3	0	95-100	95-100	50-70	3-15	---	NP
Valentine-------	0-9	Fine sand--------	SM, SP-SM, SP	A-2, A-3	0	100	100	70-100	2-25	---	NP
	9-60	Fine sand, loamy fine sand, loamy sand.	SM, SP-SM, SP	A-2, A-3	0	100	100	90-100	2-20	---	NP
SkB-------------- Simeon	0-4	Loamy sand-------	SM, SP-SM	A-2, A-3	0	95-100	90-100	51-80	5-35	<20	NP
	4-60	Sand, coarse sand, loamy sand.	SP, SP-SM, SM	A-1, A-2, A-3	0	90-100	75-100	40-80	2-30	---	NP

See footnotes at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
SmD*:											
Simeon----------	0-6	Loamy sand-------	SM, SP-SM	A-2, A-3	0	95-100	90-100	51-80	5-35	<20	NP
	6-60	Sand, coarse sand, loamy sand.	SP, SP-SM, SM	A-1, A-2, A-3	0	90-100	75-100	40-80	2-30	---	NP
Meadin----------	0-9	Sandy loam-------	SM, ML, CL-ML, SM-SC	A-2, A-4	0	85-100	75-95	45-80	25-55	<20	NP-5
	9-60	Gravelly coarse sand, coarse sand, gravelly sand.	SP-SM, SP, GP-GM, GP	A-1	0	40-80	40-70	15-50	1-10	---	NP
SvG2*:											
Simeon----------	0-8	Sand-------------	SM, SP-SM	A-2, A-3	0	95-100	90-100	51-80	5-20	<20	NP
	8-60	Sand, coarse sand, loamy sand.	SP, SP-SM, SM	A-1, A-2, A-3	0	90-100	75-100	40-80	2-30	---	NP
Valentine-------	0-9	Sand-------------	SM, SP-SM, SP	A-2, A-3	0	100	100	70-100	2-25	---	NP
	9-60	Fine sand, sand, loamy sand.	SM, SP-SM, SP	A-2, A-3	0	100	100	90-100	2-20	---	NP
TdG*:											
Tassel----------	0-14	Loamy sand-------	SM	A-2	0	95-100	90-100	65-95	15-30	---	NP
	14-19	Fine sandy loam, loamy very fine sand, sandy loam.	ML, SM	A-4	0	95-100	90-100	65-95	40-65	<35	NP-7
	19-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Valentine-------	0-7	Loamy fine sand	SM, SP-SM, SP	A-2, A-3	0	100	100	95-100	2-35	---	NP
	7-60	Fine sand, loamy fine sand, loamy sand.	SM, SP-SM, SP	A-2, A-3	0	100	100	90-100	2-20	---	NP
Duda------------	0-6	Loamy sand-------	SM, SM-SC	A-2	0	100	100	50-75	15-35	<25	NP-5
	6-32	Loamy fine sand, loamy sand, fine sand.	SM, SM-SC	A-2, A-1	0	100	100	45-75	15-35	<25	NP-5
	32-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Tn--------------- Tryon	0-5	Loamy fine sand	SM, SP-SM	A-2	0	100	100	85-100	10-30	---	NP
	5-60	Fine sand, loamy sand, sand.	SP-SM, SM	A-2, A-3	0	100	100	51-90	5-30	---	NP
To--------------- Tryon	0-6	Loamy fine sand	SM, SP-SM	A-2	0	100	100	85-100	10-30	---	NP
	6-60	Fine sand, loamy sand, sand.	SP-SM, SM	A-2, A-3	0	100	50-90	50-90	5-30	---	NP
TpB*:											
Tryon-----------	0-8	Loamy sand-------	SM, SP-SM	A-2	0	100	100	85-100	10-30	---	NP
	8-60	Fine sand, loamy sand, sand.	SP-SM, SM	A-2, A-3	0	100	100	51-90	5-30	---	NP
Els-------------	0-7	Loamy sand-------	SP-SM, SM	A-2, A-3	0	100	100	70-100	5-35	---	NP
	7-60	Fine sand, loamy sand, sand.	SP-SM, SM, SP	A-2, A-3	0	90-100	90-100	70-100	4-30	---	NP

See footnotes at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
VaB, VaD, VaE, VaG-------------- Valentine	0-4	Fine sand--------	SM, SP-SM, SP	A-2, A-3	0	100	100	70-100	2-25	---	NP
	4-60	Fine sand, loamy fine sand, loamy sand.	SM, SP-SM, SP	A-2, A-3	0	100	100	90-100	2-20	---	NP
VbB, VbD--------- Valentine	0-6	Loamy fine sand	SM, SP-SM, SP	A-2, A-3	0	100	100	95-100	2-35	---	NP
	6-60	Fine sand, loamy fine sand, loamy sand.	SM, SP-SM, SP	A-2, A-3	0	100	100	90-100	2-20	---	NP
VdD*:											
Valentine-------	0-6	Fine sand--------	SM, SP-SM, SP	A-2, A-3	0	100	100	70-100	2-25	---	NP
	6-60	Fine sand, loamy fine sand, loamy sand.	SM, SP-SM, SP	A-2, A-3	0	100	100	90-100	2-20	---	NP
Boelus----------	0-12	Fine sand--------	SM	A-2	0	100	100	50-95	15-35	---	NP
	12-36	Loamy fine sand, sand, fine sand.	SM, SP-SM, SP	A-2, A-3	0	100	100	50-95	2-35	---	NP
	36-52	Loam, clay loam, sandy clay loam.	CL, SC	A-7, A-6, A-7	0	100	100	80-95	40-80	34-50	15-30
	52-60	Gravelly coarse sand, coarse sand.	SP, SP-SM	A-2, A-3, A-1	0	55-90	50-75	25-55	2-12	---	NP
VfD*:											
Valentine-------	0-6	Fine sand--------	SM, SP-SM, SP	A-2, A-3	0	100	100	70-100	2-25	---	NP
	6-60	Fine sand, loamy fine sand, loamy sand.	SM, SP-SM, SP	A-2, A-3	0	100	100	90-100	2-20	---	NP
Els-------------	0-6	Fine sand--------	SP-SM, SM	A-2, A-3	0	100	100	70-100	5-35	---	NP
	6-60	Fine sand, loamy sand, sand.	SP-SM, SM, SP	A-2, A-3	0	90-100	90-100	70-100	4-30	---	NP
VoB-------------- Vetal	0-22	Loam-------------	CL, CL-ML ML	A-4, A-6	0	100	100	90-100	50-60	25-35	3-12
	22-28	Fine sandy loam, very fine sandy loam, sandy loam.	SM, ML, CL-ML, SM-SC	A-4, A-2	0	100	100	60-95	30-65	20-30	NP-7
	28-60	Sandy loam, loamy sand, sand.	SM, SM-SC, SP-SM	A-4, A-2, A-3	0	100	100	50-75	5-40	<20	NP-7
WeC-------------- Wewela	0-7	Fine sandy loam	ML, SM, CL-ML, SM-SC	A-4	0	100	100	70-85	40-55	15-30	NP-7
	7-18	Sandy clay loam, clay loam, loam.	SC, CL	A-6, A-7	0	100	100	60-100	35-55	30-45	10-20
	18-36	Clay, shaly clay, shaly silty clay.	CH, MH	A-7	0	100	95-100	90-100	85-100	55-85	20-50
	36-60	Weathered bedrock	---	---	---	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.
** NP means nonplastic.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH	mmhos/cm					Pct
Ba*:												
Barney----------	0-7	5-15	1.50-1.70	2.0-20	0.10-0.18	6.6-8.4	<2	Low--------	0.20	2	3	1-3
	7-17	3-10	1.60-1.80	2.0-20	0.09-0.14	7.4-8.4	<2	Low--------	0.17			
	17-60	0-5	1.70-1.90	>6.0	0.02-0.04	6.6-7.8	<2	Low--------	0.10			
Boel------------	0-15	2-10	1.60-1.80	6.0-20	0.10-0.12	6.6-8.4	<2	Low--------	0.17	5	2	1-2
	15-60	0-6	1.50-1.60	6.0-20	0.05-0.10	6.6-8.4	<2	Low--------	0.20			
Bm--------------- Boel	0-8	2-10	1.60-1.80	6.0-20	0.10-0.12	6.6-8.4	<2	Low--------	0.17	5	2	1-2
	8-60	0-6	1.50-1.60	6.0-20	0.05-0.10	6.6-8.4	<2	Low--------	0.20			
BpB-------------- Boelus	0-14	2-12	1.70-1.90	6.0-20	0.10-0.12	5.6-7.3	<2	Low--------	0.17	5	2	1-3
	14-23	2-12	1.70-1.90	6.0-20	0.09-0.11	6.1-7.8	<2	Low--------	0.17			
	23-37	15-28	1.40-1.60	0.6-2.0	0.17-0.22	6.1-8.4	<2	Moderate	0.43			
	37-60	15-28	1.30-1.50	0.6-2.0	0.17-0.22	6.1-8.4	<2	Moderate	0.43			
BrD*:												
Brunswick--------	0-4	4-12	1.40-1.65	6.0-20	0.10-0.12	5.1-6.5	<2	Low--------	0.17	4	2	.5-1
	4-19	8-18	1.40-1.60	2.0-20	0.09-0.14	4.5-7.3	<2	Low--------	0.20			
	19-24	4-10	1.40-1.70	2.0-20	0.05-0.11	5.1-7.8	<2	Low--------	0.20			
	24-60	---	---	---	---	---	---	----------	----			
Tassel----------	0-6	2-8	1.60-1.80	6.0-20	0.10-0.12	7.4-8.4	<2	Low--------	0.17	2	2	.5-1
	6-12	5-12	1.50-1.75	2.0-6.0	0.15-0.17	7.4-8.4	<2	Low--------	0.24			
	12-60	---	---	---	---	---	---	----------	----			
BtF*:												
Brunswick--------	0-4	8-18	1.50-1.60	0.6-6.0	0.16-0.18	5.1-6.5	<2	Low--------	0.20	4	3	.5-1
	4-19	8-18	1.40-1.60	2.0-20	0.09-0.14	4.5-7.3	<2	Low--------	0.20			
	19-24	4-10	1.40-1.70	2.0-20	0.05-0.11	5.1-7.8	<2	Low--------	0.20			
	24-60	---	---	---	---	---	---	----------	----			
Tassel----------	0-6	5-12	1.50-1.75	2.0-6.0	0.16-0.18	7.4-8.4	<2	Low--------	0.24	2	3	.5-1
	6-12	5-12	1.50-1.75	2.0-6.0	0.15-0.17	7.4-8.4	<2	Low--------	0.24			
	12-60	---	---	---	---	---	---	----------	----			
DuB-------------- Dunday	0-11	3-10	1.40-1.60	6.0-20	0.10-0.12	6.1-7.3	<2	Low--------	0.17	5	2	1-2
	11-60	2-7	1.50-1.70	6.0-20	0.09-0.11	6.1-7.8	<2	Low--------	0.17			
Eo--------------- Els	0-4	2-8	1.60-1.80	6.0-20	0.07-0.12	6.1-8.4	<2	Low--------	0.17	5	2	.5-2
	4-60	0-8	1.50-1.60	6.0-20	0.05-0.08	6.1-8.4	<2	Low--------	0.15			
EpB*:												
Els-------------	0-9	2-8	1.60-1.80	6.0-20	0.07-0.12	6.1-8.4	<2	Low--------	0.17	5	2	.5-2
	9-60	0-8	1.50-1.60	6.0-20	0.05-0.08	6.1-8.4	<2	Low--------	0.15			
Ipage-----------	0-5	1-5	1.40-1.50	6.0-20	0.07-0.09	5.1-7.8	<2	Low--------	0.15	5	1	.5-1
	5-60	1-8	1.50-1.60	6.0-20	0.04-0.10	5.1-7.8	<2	Low--------	0.17			
ErC*:												
Els-------------	0-6	2-8	1.60-1.80	6.0-20	0.07-0.12	6.1-8.4	<2	Low--------	0.17	5	2	.5-2
	6-60	0-8	1.50-1.60	6.0-20	0.05-0.08	6.1-8.4	<2	Low--------	0.15			
Ipage-----------	0-8	3-10	1.40-1.50	6.0-20	0.10-0.12	5.1-7.8	<2	Low--------	0.17	5	2	.5-2
	8-60	1-8	1.50-1.60	6.0-20	0.04-0.10	5.1-7.8	<2	Low--------	0.17			
Tryon-----------	0-3	3-10	1.40-1.60	6.0-20	0.10-0.12	5.6-8.4	<2	Low--------	0.17	5	8	4-8
	3-60	1-7	1.50-1.70	6.0-20	0.06-0.08	5.6-7.8	<2	Low--------	0.17			
Es--------------- Elsmere	0-19	3-10	1.90-2.10	6.0-20	0.10-0.12	5.6-8.4	<2	Low--------	0.17	5	2	2-3
	19-60	0-8	1.90-2.10	6.0-20	0.06-0.11	5.6-8.4	<2	Low--------	0.17			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH	mmhos/cm					Pct
ExB*:												
Elsmere----------	0-10	3-10	1.90-2.10	6.0-20	0.10-0.12	5.6-8.4	<2	Low--------	0.17	5	2	1-3
	10-60	0-8	1.90-2.10	6.0-20	0.06-0.11	5.6-8.4	<2	Low--------	0.17			
Selia-----------	0-4	3-12	1.80-1.90	6.0-20	0.10-0.12	6.6-9.0	<4	Low--------	0.17	3	2	.5-4
	4-26	6-15	1.70-2.00	0.06-0.2	0.09-0.12	>8.4	<8	Low--------	0.17			
	26-60	1-18	1.80-2.10	6.0-20	0.05-0.10	>6.5	<2	Low--------	0.17			
IgB-------------- Ipage	0-9	3-10	1.40-1.50	6.0-20	0.10-0.12	5.1-7.8	<2	Low--------	0.17	5	2	.5-2
	9-60	1-8	1.50-1.60	6.0-20	0.04-0.10	5.1-7.8	<2	Low--------	0.17			
JsB-------------- Jansen	0-11	2-8	1.60-1.80	6.0-20	0.07-0.12	5.1-7.3	<2	Low--------	0.17	4	2	1-2
	11-24	18-32	1.10-1.25	0.6-2.0	0.15-0.19	5.1-7.3	<2	Moderate	0.32			
	24-60	0-3	1.50-1.70	>20	0.02-0.04	5.1-7.3	<2	Low--------	0.10			
LcG*:												
Labu------------	0-6	45-60	1.20-1.30	0.06-0.2	0.08-0.14	6.6-8.4	<2	High-------	0.32	4	4	1-3
	6-35	45-60	1.20-1.30	0.06-0.2	0.08-0.14	7.4-8.4	<2	High-------	0.32			
	35-60	---	---	---	---	---	---	----------	----			
Sansarc----------	0-4	55-65	1.10-1.20	0.06-0.2	0.08-0.12	6.6-8.4	<2	Very high	0.37	2	4	1-2
	4-18	55-65	1.10-1.20	0.06-0.2	0.08-0.12	7.4-8.4	<2	Very high	0.37			
	18-60	---	---	---	---	5.6-8.4	---	----------	----			
LfB-------------- Libory	0-14	2-12	1.60-1.80	6.0-20	0.07-0.12	5.6-7.3	<2	Low--------	0.17	5	2	1-3
	14-24	2-12	1.60-1.80	6.0-20	0.06-0.11	5.6-7.3	<2	Low--------	0.17			
	24-60	15-32	1.20-1.40	0.2-2.0	0.17-0.22	5.6-7.8	<2	Low--------	0.43			
Lo--------------- Loup	0-10	5-15	1.30-1.50	2.0-6.0	0.16-0.18	6.6-8.4	<2	Low--------	0.20	5	8	4-8
	10-60	2-7	1.50-1.70	6.0-20	0.06-0.08	6.6-8.4	<2	Low--------	0.17			
Lp--------------- Loup	0-19	5-15	1.30-1.50	2.0-6.0	0.16-0.18	6.6-8.4	<2	Low--------	0.20	5	8	4-8
	19-48	2-7	1.50-1.70	6.0-20	0.06-0.08	6.6-8.4	<2	Low--------	0.17			
	48-60	10-18	1.30-1.40	2.0-6.0	0.15-0.17	6.1-8.4	<2	Low--------	0.17			
Ma--------------- Marlake	0-8	3-10	1.50-1.60	6.0-20	0.10-0.14	6.6-8.4	<2	Low--------	0.17	2	8	4-8
	8-19	3-8	1.50-1.60	6.0-20	0.06-0.11	6.6-8.4	<2	Low--------	0.17			
	19-60	0-5	1.50-1.60	6.0-20	0.05-0.07	6.6-8.4	<2	Low--------	0.17			
MeB-------------- Meadin	0-8	5-12	1.50-1.60	0.6-2.0	0.13-0.18	5.1-7.3	<2	Low--------	0.20	3	3	1-2
	8-24	3-18	1.50-1.60	6.0-20	0.09-0.11	5.1-7.3	<2	Low--------	0.10			
	24-60	2-5	1.50-1.70	>20	0.02-0.05	6.1-7.3	<2	Low--------	0.10			
Oe, OeC---------- O'Neill	0-7	3-12	1.60-1.80	2.0-20	0.10-0.18	5.1-6.5	<2	Low--------	0.20	4	3	1-3
	7-32	6-18	1.60-1.80	2.0-6.0	0.15-0.17	6.6-7.3	<2	Low--------	0.20			
	32-60	0-3	1.50-1.70	>20	0.02-0.04	6.6-7.3	<2	Low--------	0.10			
OhD*:												
O'Neill----------	0-14	3-12	1.60-1.80	2.0-20	0.10-0.18	5.1-6.5	<2	Low--------	0.20	4	3	1-3
	14-36	6-18	1.60-1.80	2.0-6.0	0.15-0.17	6.6-7.3	<2	Low--------	0.20			
	36-60	0-3	1.50-1.70	>20	0.02-0.04	6.6-7.3	<2	Low--------	0.10			
Meadin----------	0-16	5-12	1.50-1.60	0.6-2.0	0.13-0.18	5.1-7.3	<2	Low--------	0.20	3	3	1-2
	16-60	2-5	1.50-1.70	>20	0.02-0.05	6.1-7.3	<2	Low--------	0.10			
Or--------------- Ord	0-18	8-15	1.40-1.60	0.6-2.0	0.20-0.22	7.4-8.4	<2	Low--------	0.24	5	4L	2-4
	18-21	8-15	1.50-1.70	2.0-6.0	0.15-0.17	6.6-8.4	<2	Low--------	0.20			
	21-60	3-12	1.60-1.80	2.0-20	0.02-0.04	6.6-8.4	<2	Low--------	0.20			
PtB-------------- Pivot	0-13	3-12	1.40-1.60	6.0-20	0.10-0.12	5.6-7.3	<2	Low--------	0.17	4	2	1-2
	13-27	2-10	1.40-1.70	6.0-20	0.09-0.11	5.6-7.3	<2	Low--------	0.15			
	27-60	1-8	1.50-1.70	6.0-20	0.06-0.08	5.6-7.3	<2	Low--------	0.15			
PvD*:												
Pivot-----------	0-11	3-12	1.40-1.60	6.0-20	0.10-0.12	5.6-7.3	<2	Low--------	0.17	4	2	1-2
	11-24	2-10	1.40-1.70	6.0-20	0.09-0.11	5.6-7.3	<2	Low--------	0.15			
	24-60	1-8	1.50-1.70	6.0-20	0.06-0.08	5.6-7.3	<2	Low--------	0.15			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH	mmhos/cm					Pct
PvD*:												
Valentine--------	0-9	0-6	1.70-1.90	6.0-20	0.07-0.09	5.6-7.3	<2	Low--------	0.15	5	1	.5-1
	9-60	0-8	1.70-1.90	6.0-20	0.05-0.11	5.6-7.3	<2	Low--------	0.15			
SkB--------------- Simeon	0-4	5-12	1.30-1.50	6.0-20	0.08-0.14	6.1-7.8	<2	Low--------	0.17	5	2	.5-1
	4-60	2-10	1.50-1.70	6.0-20	0.05-0.10	6.1-7.8	<2	Low--------	0.15			
SmD*:												
Simeon-----------	0-6	5-12	1.30-1.50	6.0-20	0.08-0.14	6.1-7.8	<2	Low--------	0.17	5	2	.5-1
	6-60	2-10	1.50-1.70	6.0-20	0.05-0.10	6.1-7.8	<2	Low--------	0.15			
Meadin-----------	0-9	5-12	1.50-1.60	0.6-2.0	0.13-0.18	5.1-7.3	<2	Low--------	0.20	3	3	1-2
	9-60	2-5	1.50-1.70	>20	0.02-0.05	6.1-7.3	<2	Low--------	0.10			
SvG2*:												
Simeon-----------	0-8	3-10	1.30-1.50	6.0-20	0.06-0.12	6.1-7.8	<2	Low--------	0.15	5	1	.5-1
	8-60	2-10	1.50-1.70	6.0-20	0.05-0.10	6.1-7.8	<2	Low--------	0.15			
Valentine--------	0-9	0-6	1.70-1.90	6.0-20	0.07-0.09	5.6-7.3	<2	Low--------	0.15	5	1	.5-1
	9-60	0-8	1.70-1.90	6.0-20	0.05-0.11	5.6-7.3	<2	Low--------	0.15			
TdG*:												
Tassel-----------	0-14	2-8	1.60-1.80	6.0-20	0.10-0.12	7.4-8.4	<2	Low--------	0.17	2	2	.5-1
	14-19	5-12	1.50-1.75	2.0-6.0	0.15-0.17	7.4-8.4	<2	Low--------	0.24			
	19-60	---	---	---	---	---	---	-----------	----			
Valentine--------	0-7	2-10	1.70-1.90	6.0-20	0.10-0.12	5.6-7.3	<2	Low--------	0.17	5	2	.5-1
	7-60	0-8	1.70-1.90	6.0-20	0.05-0.11	5.6-7.3	<2	Low--------	0.15			
Duda-------------	0-6	3-10	1.15-1.25	2.0-20	0.10-0.12	6.1-7.3	<2	Low--------	0.17	4	2	.5-2
	6-32	3-10	1.45-1.60	2.0-20	0.08-0.10	6.1-7.8	<2	Low--------	0.17			
	32-60	---	---	---	---	---	---	-----------	----			
Tn--------------- Tryon	0-5	3-10	1.40-1.60	6.0-20	0.10-0.12	5.6-8.4	<2	Low--------	0.17	5	8	4-8
	5-60	1-7	1.50-1.70	6.0-20	0.06-0.08	5.6-7.8	<2	Low--------	0.17			
To--------------- Tryon	0-6	3-10	1.40-1.60	6.0-20	0.10-0.12	5.6-8.4	<2	Low--------	0.17	5	8	4-8
	6-60	1-7	1.50-1.70	6.0-20	0.06-0.08	5.6-7.8	<2	Low--------	0.17			
TpB*:												
Tryon------------	0-8	3-10	1.40-1.60	6.0-20	0.10-0.12	5.6-8.4	<2	Low--------	0.17	5	8	4-8
	8-60	1-7	1.50-1.70	6.0-20	0.06-0.08	5.6-7.8	<2	Low--------	0.17			
Els--------------	0-7	2-8	1.60-1.80	6.0-20	0.07-0.12	6.1-8.4	<2	Low--------	0.17	5	2	.5-2
	7-60	0-8	1.50-1.60	6.0-20	0.05-0.08	6.1-8.4	<2	Low--------	0.15			
VaB, VaD, VaE, VaG-------------- Valentine	0-4	0-6	1.70-1.90	6.0-20	0.07-0.09	5.6-7.3	<2	Low--------	0.15	5	1	.5-1
	4-60	0-8	1.70-1.90	6.0-20	0.05-0.11	5.6-7.3	<2	Low--------	0.15			
VbB, VbD--------- Valentine	0-6	2-10	1.70-1.90	6.0-20	0.10-0.12	5.6-7.3	<2	Low--------	0.17	5	2	.5-1
	6-60	0-8	1.70-1.90	6.0-20	0.05-0.11	5.6-7.3	<2	Low--------	0.15			
VdD*:												
Valentine--------	0-6	0-6	1.70-1.90	6.0-20	0.07-0.09	5.6-7.3	<2	Low--------	0.15	5	1	.5-1
	6-60	0-8	1.70-1.90	6.0-20	0.05-0.11	5.6-7.3	<2	Low--------	0.15			
Boelus-----------	0-12	4-12	1.35-1.55	6.0-20	0.10-0.12	5.6-7.3	<2	Low--------	0.17	5	1	1-3
	12-36	2-10	1.40-1.60	6.0-20	0.06-0.11	5.6-7.3	<2	Low--------	0.17			
	36-52	24-35	1.60-1.75	0.6-2.0	0.14-0.18	5.6-8.4	<2	High-------	0.32			
	52-60	1-8	1.50-1.70	>20	0.02-0.04	5.6-7.3	<2	Low--------	0.10			
VfD*:												
Valentine--------	0-6	0-6	1.70-1.90	6.0-20	0.07-0.09	5.6-7.3	<2	Low--------	0.15	5	1	.5-1
	6-60	0-8	1.70-1.90	6.0-20	0.05-0.11	5.6-7.3	<2	Low--------	0.15			
Els--------------	0-6	2-8	1.60-1.80	6.0-20	0.07-0.12	6.1-8.4	<2	Low--------	0.15	5	1	.5-2
	6-60	0-8	1.50-1.60	6.0-20	0.05-0.08	6.1-8.4	<2	Low--------	0.15			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea-bility	Available water capacity	Reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH	mmhos/cm					Pct
VoB---------------- Vetal	0-22	10-18	1.20-1.30	2.0-6.0	0.17-0.19	5.6-7.3	<2	Low--------	0.28	5	5	1-3
	22-28	12-18	1.25-1.40	2.0-6.0	0.11-0.19	5.6-7.3	<2	Low--------	0.20			
	28-60	3-18	1.60-1.90	2.0-6.0	0.05-0.14	5.6-7.3	<2	Low--------	0.20			
WeC---------------- Wewela	0-7	10-18	1.25-1.40	2.0-6.0	0.14-0.17	6.1-7.3	<2	Low--------	0.20	4	3	1-2
	7-18	25-34	1.30-1.45	0.6-2.0	0.16-0.18	6.1-7.3	<2	Moderate	0.32			
	18-36	40-60	1.25-1.40	<0.2	0.08-0.12	6.1-7.8	<2	High-------	0.32			
	36-60	---	---	---	---	---	---	-----------	----			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Ba*:												
Barney-----------	D	Frequent----	Long------	Mar-Jun	0-2.0	Apparent	Nov-Jun	>60	---	Moderate	High-----	Low.
Boel-------------	A	Occasional	Brief-----	Mar-Jun	1.5-3.5	Apparent	Nov-May	>60	---	Moderate	High-----	Low.
Bm---------------- Boel	A	Occasional	Brief-----	Mar-Jun	1.5-3.5	Apparent	Nov-May	>60	---	Moderate	High-----	Low.
BpB--------------- Boelus	A	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
BrD*, BtF*:												
Brunswick--------	B	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	High-----	Low.
Tassel-----------	D	None--------	---	---	>6.0	---	---	6-20	Soft	Low------	High-----	Low.
DuB--------------- Dunday	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
Eo---------------- Els	A	Rare--------	---	---	1.5-3.0	Apparent	Nov-May	>60	---	Moderate	Moderate	Low.
EpB*:												
Els--------------	A	Rare--------	---	---	1.5-3.0	Apparent	Nov-May	>60	---	Moderate	Moderate	Low.
Ipage------------	A	None--------	---	---	3.0-6.0	Apparent	Dec-Jun	>60	---	Moderate	Low------	Moderate.
ErC*:												
Els--------------	A	Rare--------	---	---	1.5-3.0	Apparent	Nov-May	>60	---	Moderate	Moderate	Low.
Ipage------------	A	None--------	---	---	3.0-6.0	Apparent	Dec-Jun	>60	---	Moderate	Low------	Moderate.
Tryon------------	D	Rare--------	---	---	0-1.5	Apparent	Nov-May	>60	---	Moderate	High-----	Low.
Es---------------- Elsmere	A	Rare--------	---	---	1.5-2.5	Apparent	Nov-May	>60	---	Moderate	Moderate	Low.
ExB*:												
Elsmere----------	A	Rare--------	---	---	1.5-2.5	Apparent	Nov-May	>60	---	Moderate	Moderate	Low.
Selia------------	C	Rare--------	---	---	1.5-2.5	Apparent	Nov-Jun	>60	---	Moderate	High-----	Moderate.
IgB--------------- Ipage	A	None--------	---	---	3.0-6.0	Apparent	Dec-Jun	>60	---	Moderate	Low------	Moderate.
JsB--------------- Jansen	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
LcG*:												
Labu-------------	D	None--------	---	---	>6.0	---	---	20-40	Soft	Low------	High-----	Moderate.

See footnotes at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
LcG*:												
Sansarc	D	None	---	---	>6.0	---	---	4-20	Soft	Low	High	Moderate.
LfB Libory	A	None	---	---	1.5-3.0	Perched	Mar-Jun	>60	---	Low	Moderate	Low.
Lo Loup	D	Rare	---	---	0-1.5	Apparent	Nov-May	>60	---	Moderate	High	Low.
Lp** Loup	D	Rare	---	---	+.5-1.0	Apparent	Nov-May	>60	---	Moderate	High	Low.
Ma** Marlake	D	None	---	---	+2-1.0	Apparent	Oct-Jun	>60	---	Moderate	High	Low.
MeB Meadin	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
Oe, OeC O'Neill	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
OhD*:												
O'Neill	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Meadin	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
Or Ord	B	Rare	---	---	1.5-3.5	Apparent	Nov-May	>60	---	High	High	Low.
PtB Pivot	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
PvD*:												
Pivot	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
Valentine	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
SkB Simeon	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
SmD*:												
Simeon	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
Meadin	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
SvG2*:												
Simeon	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
Valentine	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
TdG*:												
Tassel	D	None	---	---	>6.0	---	---	6-20	Soft	Low	High	Low.
Valentine	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.

See footnotes at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
TdG*:												
Duda----------------	A	None---------	---	---	>6.0	---	---	20-40	Soft	Low-------	Moderate	Low.
Tn------------------ Tryon	D	Rare---------	---	---	0-1.5	Apparent	Nov-May	>60	---	Moderate	High------	Low.
To**---------------- Tryon	D	Rare---------	---	---	+.5-1.0	Apparent	Nov-May	>60	---	Moderate	High------	Low.
TpB*:												
Tryon---------------	D	Rare---------	---	---	0-1.5	Apparent	Nov-May	>60	---	Moderate	High------	Low.
Els-----------------	A	Rare---------	---	---	1.5-3.0	Apparent	Nov-May	>60	---	Moderate	Moderate	Low.
VaB, VaD, VaE, VaG, VbB, VbD----- Valentine	A	None---------	---	---	>6.0	---	---	>60	---	Low-------	Low-------	Low.
VdD*:												
Valentine-----------	A	None---------	---	---	>6.0	---	---	>60	---	Low-------	Low-------	Low.
Boelus--------------	A	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
VfD*:												
Valentine-----------	A	None---------	---	---	>6.0	---	---	>60	---	Low-------	Low-------	Low.
Els-----------------	A	Rare---------	---	---	1.5-3.0	Apparent	Nov-May	>60	---	Moderate	Moderate	Low.
VoB----------------- Vetal	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
WeC----------------- Wewela	B	None---------	---	---	>6.0	---	---	20-40	Soft	Moderate	High------	Moderate.

* See description of the map unit for composition and behavior characteristics of the map unit.

** In the "High water table--Depth" column, a plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

TABLE 17.--ENGINEERING INDEX TEST DATA

[Dashes indicate data were not available. NP means nonplastic]

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution									Liquid limit	Plasticity index	Specific gravity
			Percentage passing sieve--						Percentage smaller than--					
	AASHTO	Unified	3/4 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm			
												Pct		G/cc
Els loamy sand:[1] (S77NE149-01)														
A----- 0 to 4	A-2-4 (-2)	SM	100	100	100	100	91	14	12	3	3	NP	NP	2.60
AC---- 9 to 17	A-3(-2)	SP-SM	100	100	100	100	90	6	6	3	3	NP	NP	2.63
C----- 17 to 30	A-3(-2)	SP	100	100	100	100	94	4	3	3	3	NP	NP	2.65
Ipage fine sand:[2] (S77NE149-02)														
A----- 0 to 5	A-3(-2)	SP-SM	100	100	100	100	90	10	8	3	2	NP	NP	2.60
AC---- 5 to 16	A-3(-2)	SP-SM	100	100	100	100	90	6	4	2	2	NP	NP	2.65
C2---- 24 to 44	A-3(-2)	SP-SM	100	100	100	100	92	5	3	2	2	NP	NP	2.66
Labu silty clay:[3] (S80NE149-05)														
Bw---- 17 to 24	A-7-5 (30)	CH	100	100	100	100	100	99	98	---	50	78	46	2.73
Pivot loamy sand:[4] (S80NE149-04)														
A----- 0 to 6	A-2-4 (-1)	SM	100	100	100	100	85	22	16	5	3	18	NP	2.62
AC---- 12 to 30	A-2-4 (-2)	SM	100	100	99	97	81	13	11	6	5	NP	NP	2.63
C2---- 38 to 60	A-3(-3)	SP	99	99	98	97	65	4	4	2	2	NP	NP	2.65
Tryon loamy fine sand:[5] (S77NE149-03)														
A----- 0 to 5	A-2-4 (0)	SM	100	100	100	100	96	22	20	5	3	NP	NP	2.53
C1---- 10 to 23	A-3(-2)	SP-SM	100	100	100	100	93	8	3	1	1	NP	NP	2.65

See footnotes at end of table.

TABLE 17.--ENGINEERING INDEX TEST DATA--Continued

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution									Liquid limit	Plasticity index	Specific gravity
			Percentage passing sieve--						Percentage smaller than--					
	AASHTO	Unified	3/4 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm			
												Pct		G/cc
Valentine fine sand:[6] (S77NE149-04)														
A----- 0 to 4	A-3(-2)	SP-SM	100	100	100	100	95	10	6	3	2	NP	NP	2.62
AC---- 4 to 10	A-3(-2)	SP-SM	100	100	100	100	95	7	4	2	1	NP	NP	2.64
C----- 10 to 62	A-3(-2)	SP-SM	100	100	100	100	96	9	5	3	2	NP	NP	2.65

[1]Els loamy sand, 1,000 feet west and 900 feet south of the northeast corner, sec. 1, T. 27 N., R. 18 W.

[2]Ipage fine sand, 1,100 feet south and 50 feet west of the northeast corner, sec. 1, T. 27 N., R. 19 W.

[3]Labu silty clay, 1,000 feet north and 700 feet west of the center, sec. 32, T. 30 N., R. 20 W.

[4]Pivot loamy sand, 800 feet east and 300 feet north of the southeast corner, sec. 15, T. 31 N., R. 19 W.

[5]Tryon loamy fine sand, 1,500 feet south and 1,100 feet west of the northeast corner, sec. 1, T. 27 N., R. 19 W.

[6]Valentine fine sand, 600 feet south and 600 feet east of the center, sec. 1, T. 27 N., R. 19 N.

TABLE 18.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Barney	Sandy, mixed, mesic Mollic Fluvaquents
Boel	Sandy, mixed, mesic Fluvaquentic Haplustolls
*Boelus	Sandy over loamy, mixed, mesic Udic Haplustolls
*Brunswick	Coarse-loamy, mixed, mesic Udic Ustochrepts
Duda	Mixed, mesic Typic Ustipsamments
Dunday	Sandy, mixed, mesic Entic Haplustolls
Els	Mixed, mesic Aquic Ustipsamments
Elsmere	Sandy, mixed, mesic Aquic Haplustolls
Ipage	Mixed, mesic Aquic Ustipsamments
Jansen	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Argiustolls
Labu	Fine, montmorillonitic, mesic Vertic Ustochrepts
Libory	Sandy over loamy, mixed, mesic Aquic Haplustolls
Loup	Sandy, mixed, mesic Typic Haplaquolls
Marlake	Sandy, mixed, mesic Mollic Fluvaquents
Meadin	Sandy, mixed, mesic Entic Haplustolls
O'Neill	Coarse-loamy over sandy or sandy-skeletal, mixed, mesic Typic Haplustolls
Ord	Coarse-loamy over sandy or sandy-skeletal, mesic Aeric Calciaquolls
Pivot	Sandy, mixed, mesic Entic Haplustolls
Sansarc	Clayey, montmorillonitic (calcareous), mesic, shallow Typic Ustorthents
Selia	Sandy, mixed, mesic Typic Natraqualfs
Simeon	Mixed, mesic Typic Ustipsamments
*Tassel	Loamy, mixed (calcareous), mesic, shallow Ustic Torriorthents
Tryon	Mixed, mesic Typic Psammaquents
Valentine	Mixed, mesic Typic Ustipsamments
Vetal	Coarse-loamy, mixed, mesic Pachic Haplustolls
Wewela	Fine-loamy, mixed, mesic Typic Argiustolls

* The soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series.

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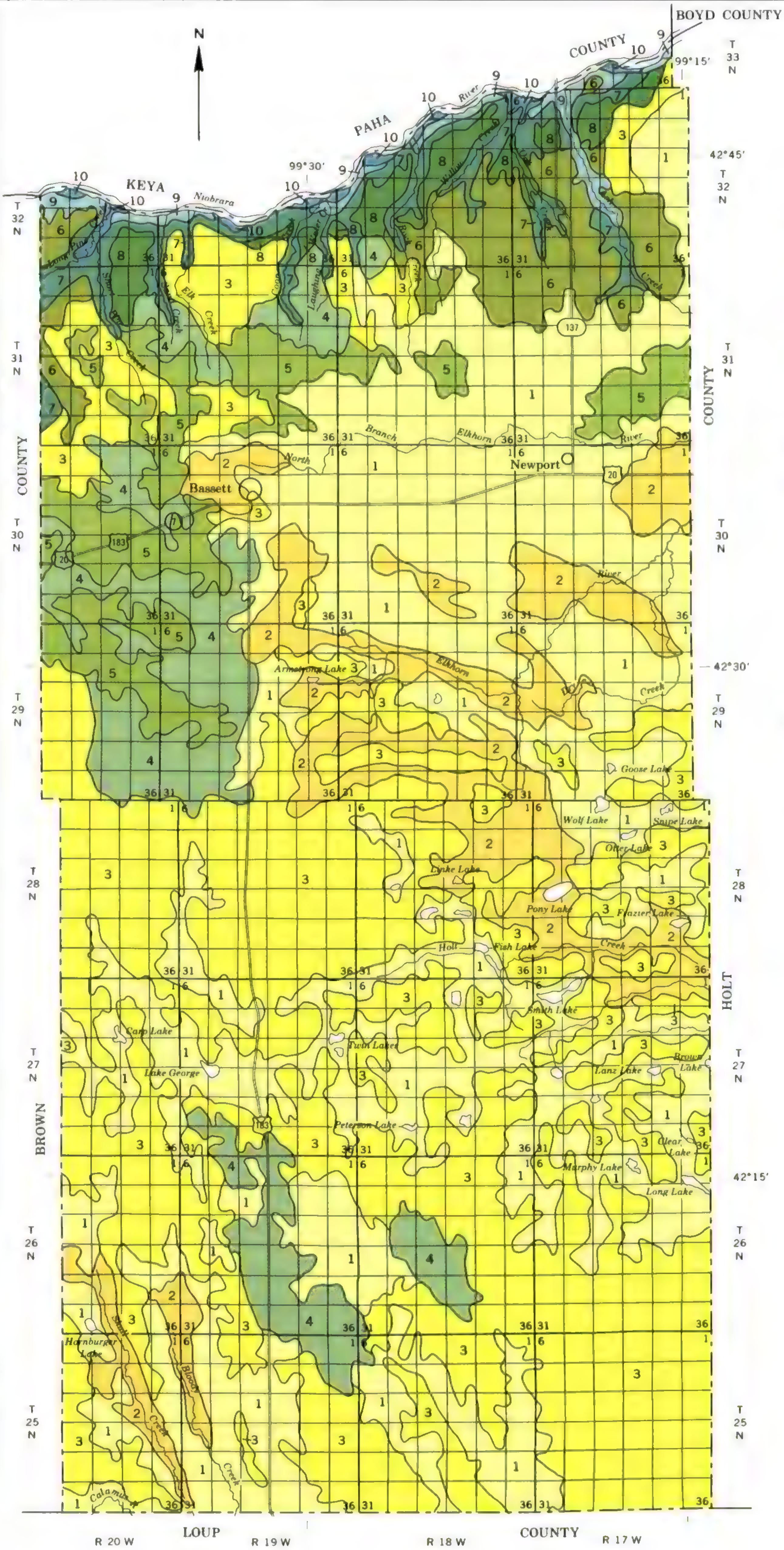


LEGEND*

NEARLY LEVEL TO STRONGLY SLOPING SOILS ON BOTTOM LANDS AND IN SANDHILL VALLEYS

1 — Els-Valentine-Tryon association: Deep, nearly level to strongly sloping, excessively drained or somewhat poorly drained to very poorly drained, sandy soils that formed in eolian and alluvial sands; on bottom lands and sand ridges and in sandhill valleys

2 — Loup-Elsmere association: Deep, nearly level and very gently sloping, somewhat poorly drained to very poorly drained, loamy and sandy soils that formed in alluvial and eolian sands; on bottom lands

NEARLY LEVEL TO VERY STEEP SOILS IN THE SANDHILLS

3 — Valentine association: Deep, nearly level to very steep, excessively drained, sandy soils that formed in eolian sand, in the sandhills

NEARLY LEVEL TO ROLLING SOILS ON UPLANDS AND IN THE SANDHILLS

4 — Valentine-Dunday association: Deep, nearly level to strongly sloping, well drained and excessively drained, sandy soils that formed in eolian sand; on uplands and in sandhills

5 — Pivot-Valentine association: Nearly level to strongly sloping, somewhat excessively drained and excessively drained, sandy soils that are moderately deep or deep over sand and gravel; on uplands

6 — Pivot-O'Neill-Valentine association: Nearly level to rolling, well drained to excessively drained, sandy and loamy soils that are moderately deep or deep over sand and gravel; on uplands

STRONGLY SLOPING TO VERY STEEP, SANDY SOILS ON BREAKS TO THE NIOBRARA RIVER VALLEY

7 — Simeon-Valentine association: Deep, strongly sloping to very steep, excessively drained, sandy soils that formed in eolian, alluvial, and outwash sands, on breaks to the Niobrara River Valley

NEARLY LEVEL AND VERY GENTLY SLOPING SOILS ON UPLANDS

8 — Pivot-Simeon association: Nearly level and very gently sloping, somewhat excessively drained and excessively drained, sandy soils that are moderately deep or deep over sand and gravel; on uplands

MODERATELY STEEP TO VERY STEEP, CLAYEY SOILS ON BREAKS TO THE NIOBRARA RIVER VALLEY

9 — Labu-Sansarc association: Moderately deep and shallow, moderately steep to very steep, well drained, clayey soils that formed in material weathered from shale; on breaks to the Niobrara River Valley

NEARLY LEVEL SOILS ON BOTTOM LANDS ALONG THE NIOBRARA RIVER

10 — Barney-Boel association: Deep, nearly level, poorly drained and somewhat poorly drained, loamy and sandy soils that formed in alluvium; on bottom lands

*Texture terms refer to the surface layer of the major soils.

Compiled 1984

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
UNIVERSITY OF NEBRASKA CONSERVATION AND SURVEY DIVISION

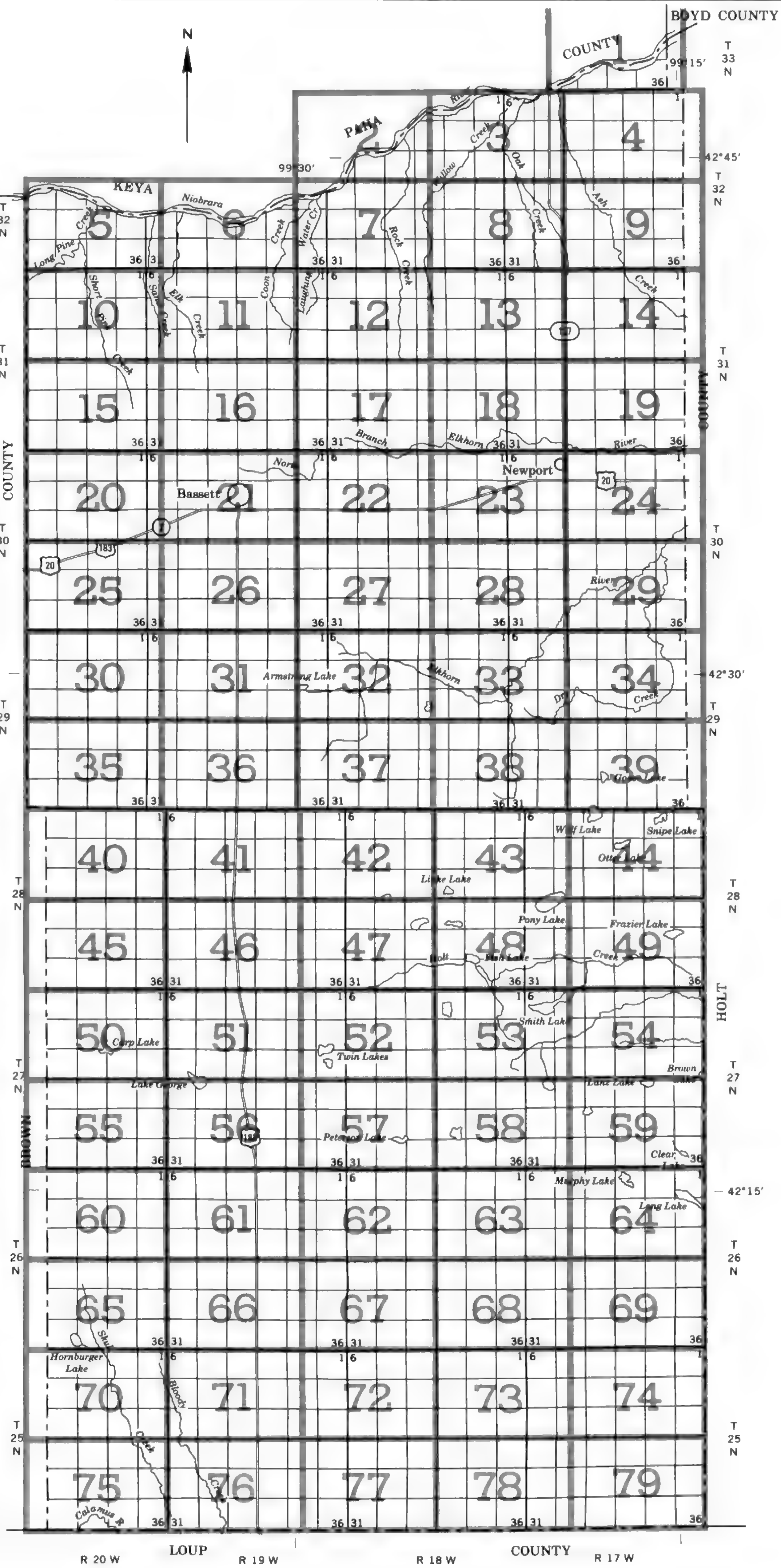
GENERAL SOIL MAP

ROCK COUNTY, NEBRASKA

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km



SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

INDEX TO MAP SHEETS

ROCK COUNTY, NEBRASKA

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km

SOIL LEGEND

Map symbols consist of a combination of letters or of letters and numbers. The first capital letter is the initial one of the map unit name. The lowercase letter that follows separates map units having names that begin with the same letter, except that it does not separate sloping or eroded phases. The second capital letter indicates the class of slope. Symbols without a slope letter are for nearly level soils. A final number 2 indicates that the soil is [redacted]

SYMBOL	NAME
[redacted]	Barney-Boel complex, channeled
[redacted]	Boel loamy fine sand, 0 to 2 percent slopes
[redacted]	Boelus loamy sand, 0 to 3 percent slopes
BrD	Brunswick-Tassel loamy sands, 3 to 11 percent slopes
BtF	Brunswick-Tassel fine sandy loams, 11 to 40 percent slopes
DuB	Dunday loamy fine sand, 0 to 3 percent slopes
[redacted]	Els loamy sand, 0 to 2 percent slopes
[redacted]	Els-Ipage complex, 0 to 3 percent slopes
ErC	Els-Ipage-Tryon loamy sands, 0 to 6 percent slopes
[redacted]	Elsmere loamy fine sand, 0 to 2 percent slopes
ExB	Elsmere-Selia loamy fine sands, 0 to 3 percent slopes
IgB	Ipage loamy sand, 0 to 3 percent slopes
[redacted]	Jensen loamy sand, 0 to 3 percent slopes
LcG	Labu-Sansarc silty clays, 11 to 40 percent slopes
LfB	Libory loamy fine sand, 0 to 3 percent slopes
Lo	Loup fine sandy loam, 0 to 2 percent slopes
Lp	Loup fine sandy loam, wet, 0 to 2 percent slopes
Me	Marlake loamy fine sand, 0 to 1 percent slopes
MeB	Meadin sandy loam, 0 to 3 percent slopes
[redacted]	O'Neill sandy loam, 0 to 2 percent slopes
OeC	O'Neill sandy loam, 2 to 6 percent slopes
[redacted]	O'Neill-Meadin sandy loams, 6 to 11 percent slopes
Or	Ord loam, 0 to 2 percent slopes
[redacted]	Pivot loamy sand, 0 to 3 percent slopes
PvD	Pivot-Valentine complex, 0 to 9 percent slopes
[redacted]	Simeon loamy sand, 0 to 3 percent slopes
[redacted]	Simeon-Meadin complex, 0 to 9 percent slopes
[redacted]	Simeon-Valentine sands, 9 to 60 percent slopes, eroded
TdG	Tassel-Valentine-Dude complex, 15 to 70 percent slopes
Tn	Tryon loamy fine sand, 0 to 2 percent slopes
To	Tryon loamy fine sand, wet, 0 to 2 percent slopes
TpB	Tryon-Els loamy sands, 0 to 3 percent slopes
VaB	Valentine fine sand, 0 to 3 percent slopes
VaD	Valentine fine sand, 3 to 9 percent slopes
VaE	Valentine fine sand, rolling
VaG	Valentine fine sand, rolling and hilly
VbB	Valentine loamy fine sand, 0 to 3 percent slopes
VbD	Valentine loamy fine sand, 3 to 9 percent slopes
VdD	Valentine-Boelus fine sands, 0 to 9 percent slopes
VfD	Valentine-Els fine sands, 0 to 9 percent slopes
VoB	Vetal loam, 1 to 3 percent slopes
WeC	Wewela fine sandy loam, 2 to 6 percent slopes

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- County
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Federal
- State

RAILROAD

DAMS

- Medium or small

PITS

- Gravel pit

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Located object (label) — Tower

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
- Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial

MISCELLANEOUS WATER FEATURES

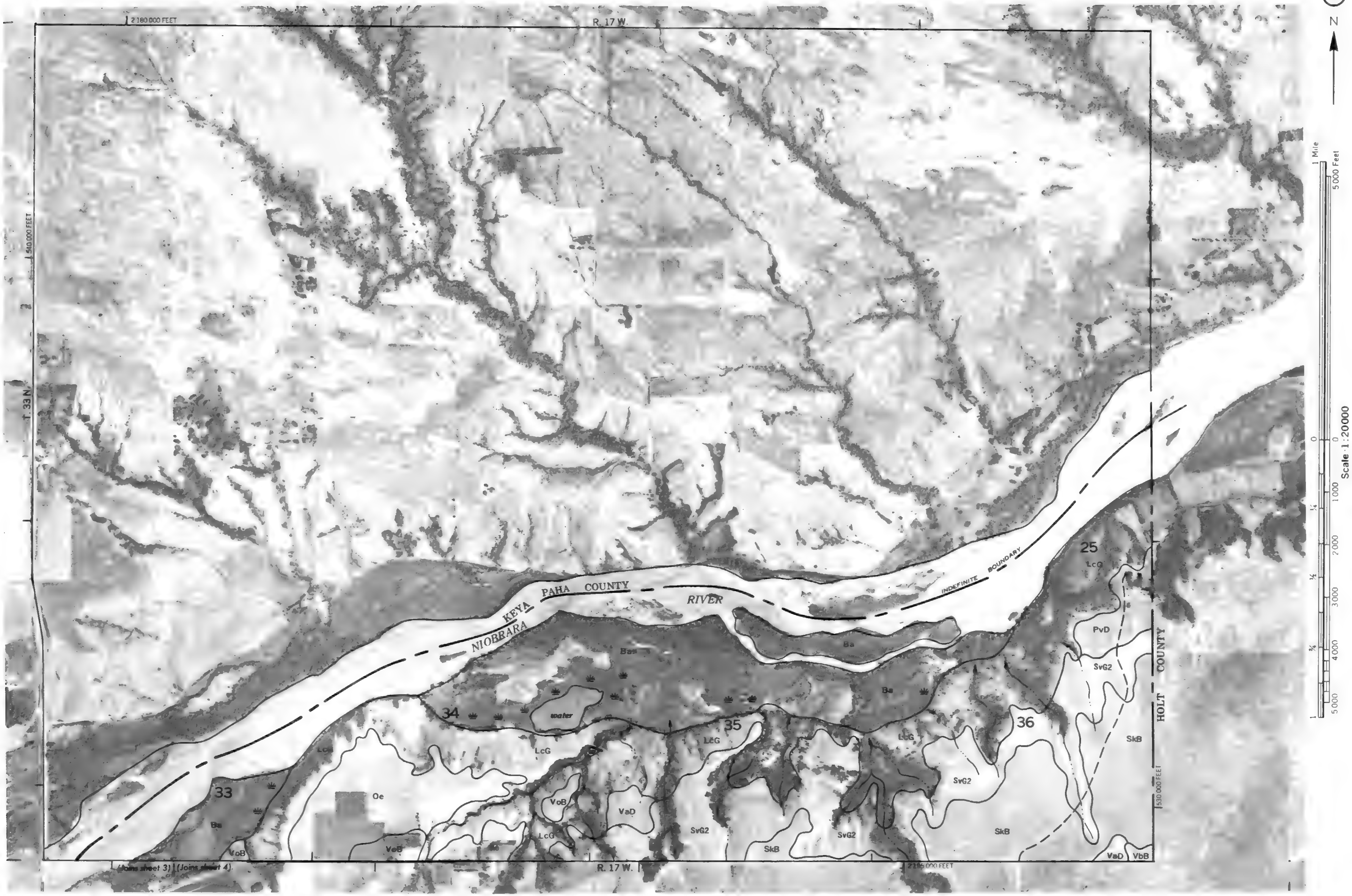
- Marsh or swamp
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — OeC PtB

MISCELLANEOUS

- [redacted]
- Gravelly spot
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Severely eroded spot
- Water Facility



ROCK COUNTY, NEBRASKA NO. 1

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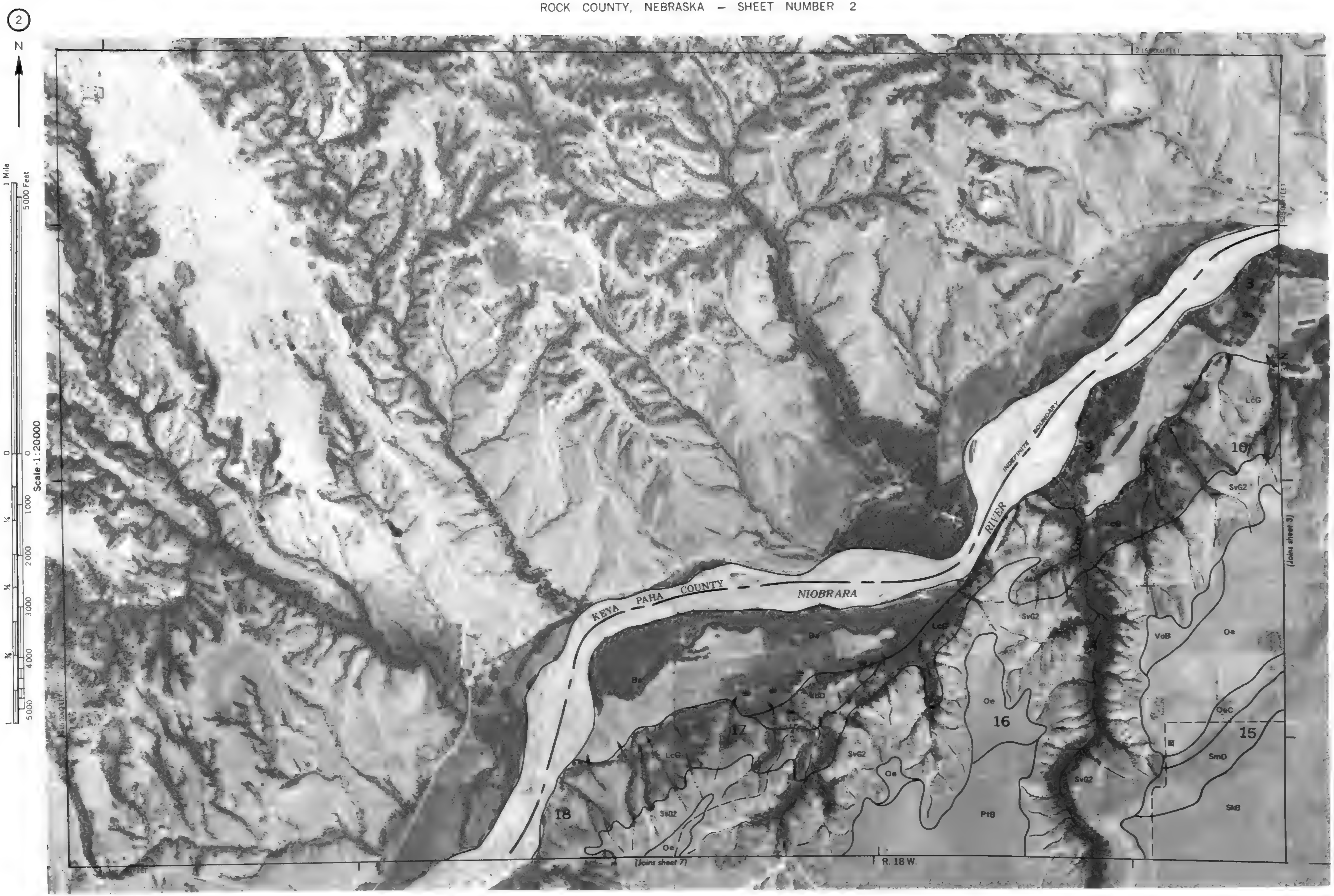
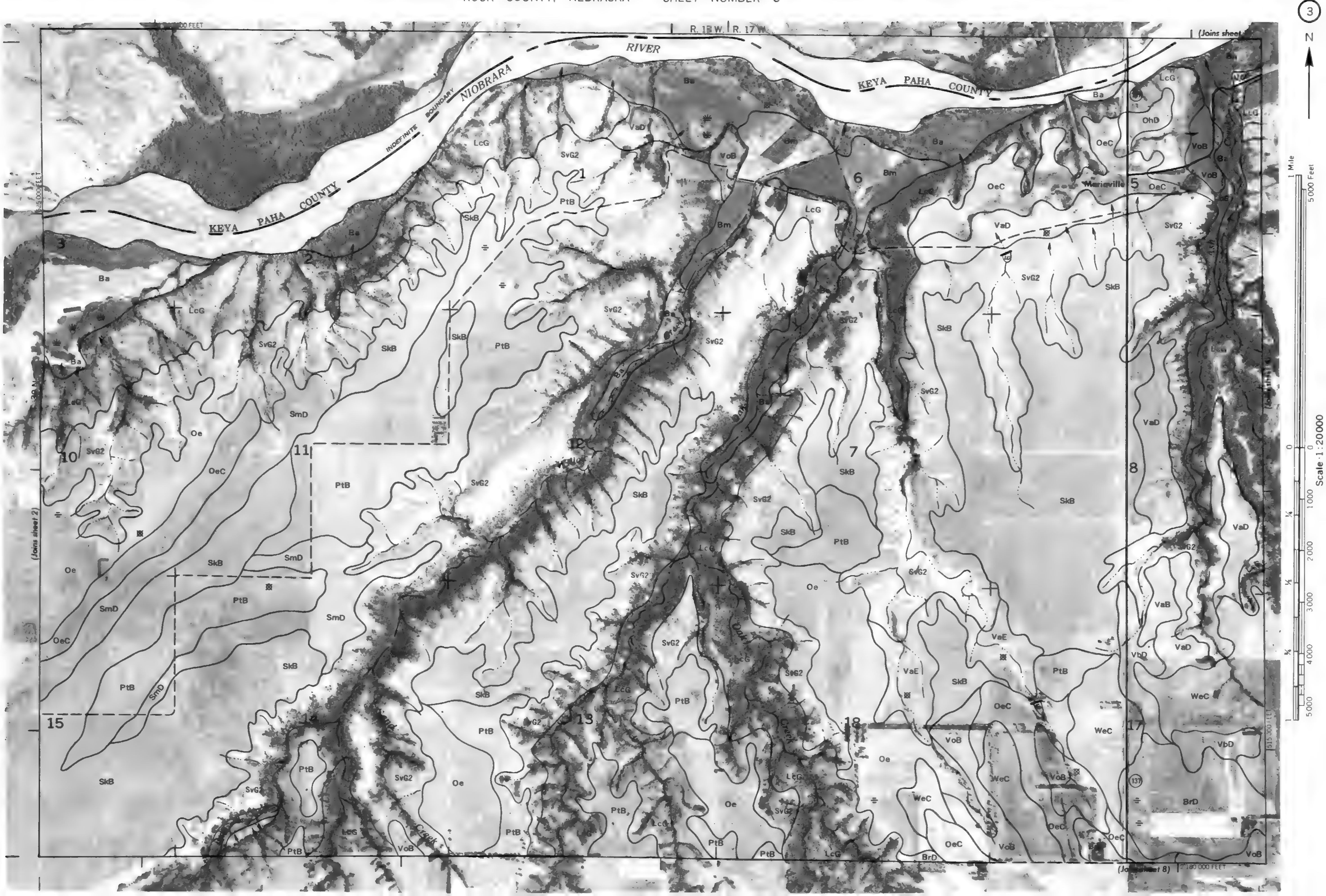

2
N
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
KEYA PAHA COUNTY
NIOBRARA
RIVER
INDEFINITE BOUNDARY
R. 18 W.
(Joins sheet 7)
(Joins sheet 3)
3
9
10
15
16
17
18
Ba
LcG
SvG2
VoB
Oe
OeC
SmD
SkB
PtB
SaD



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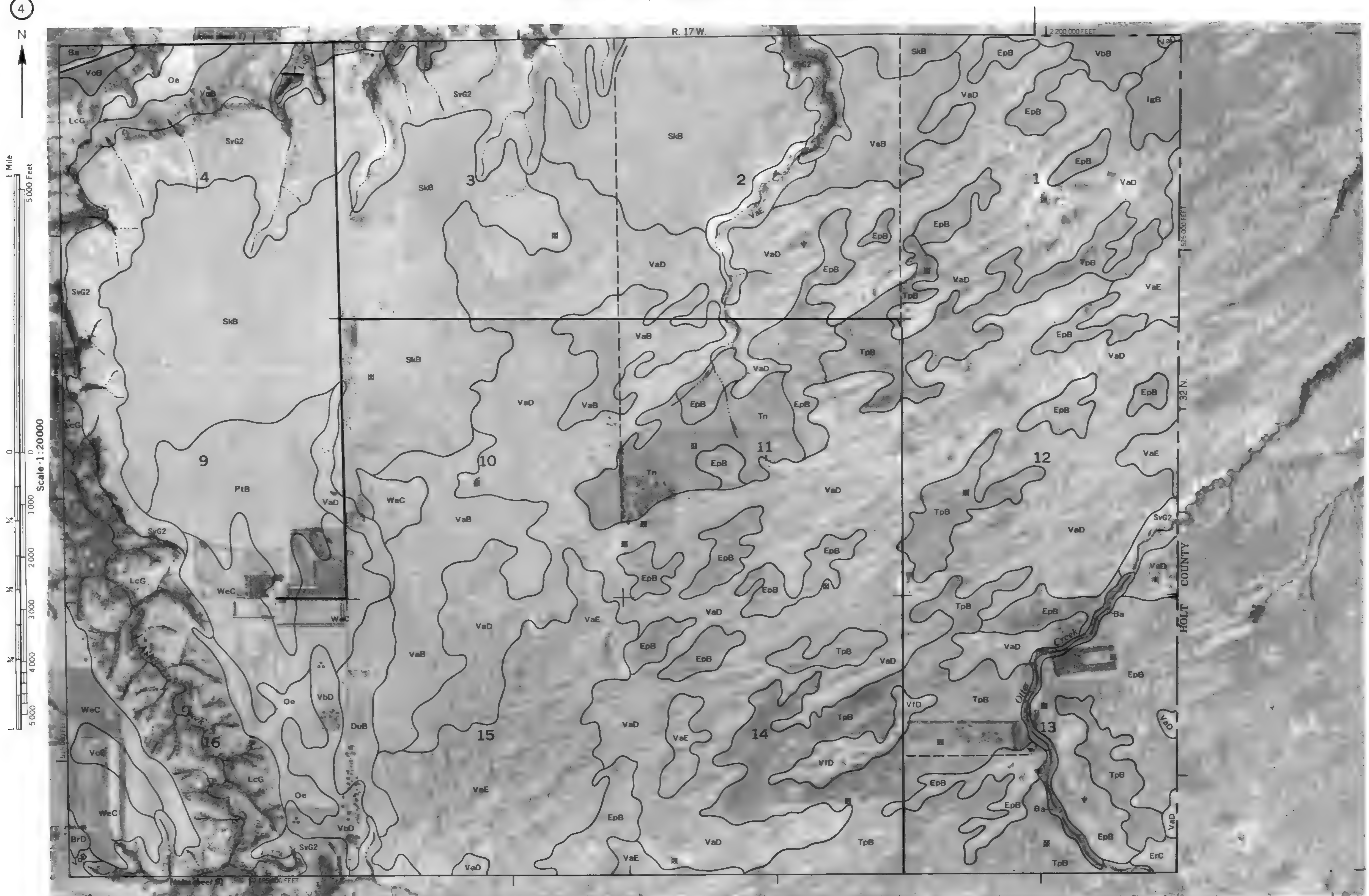

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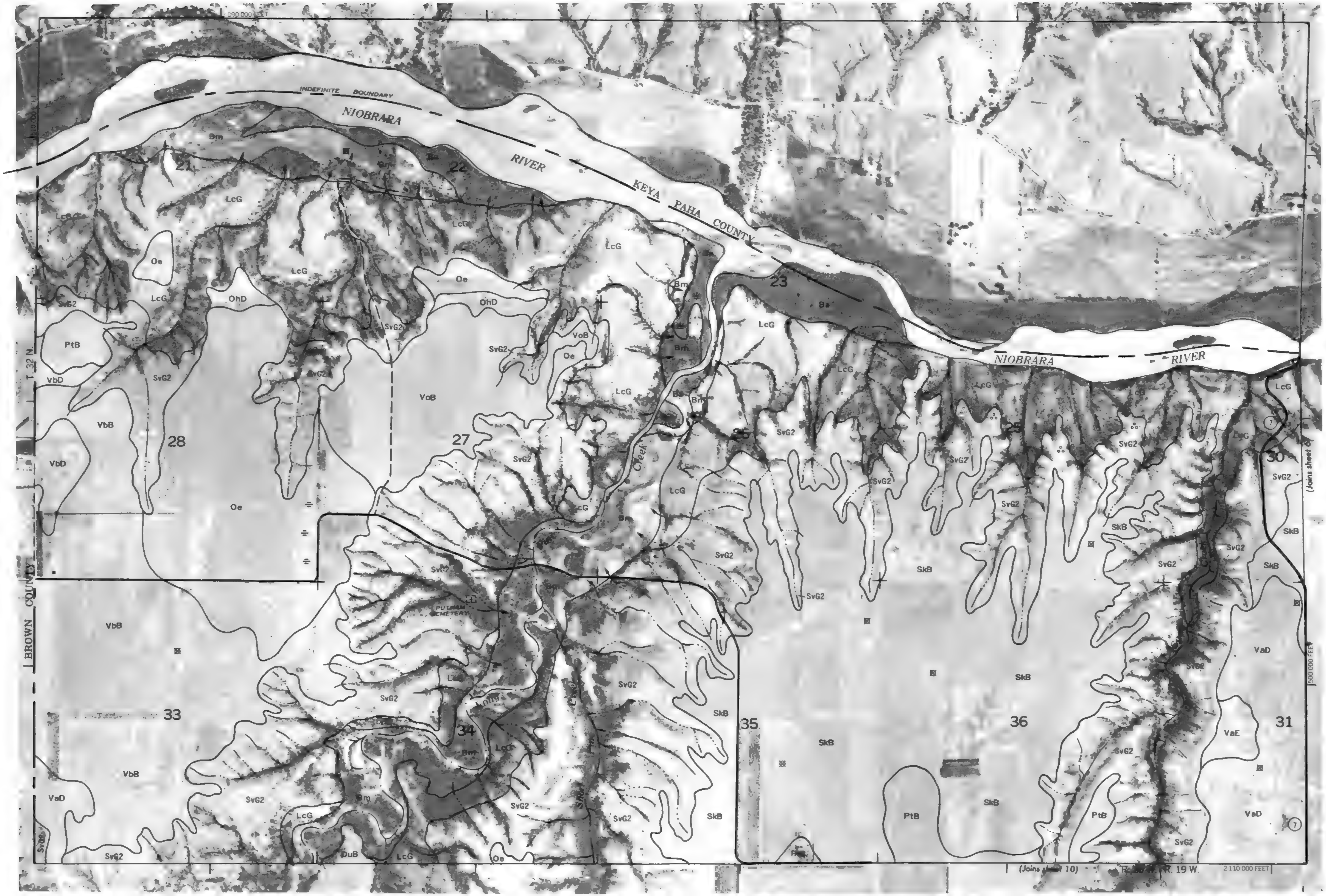
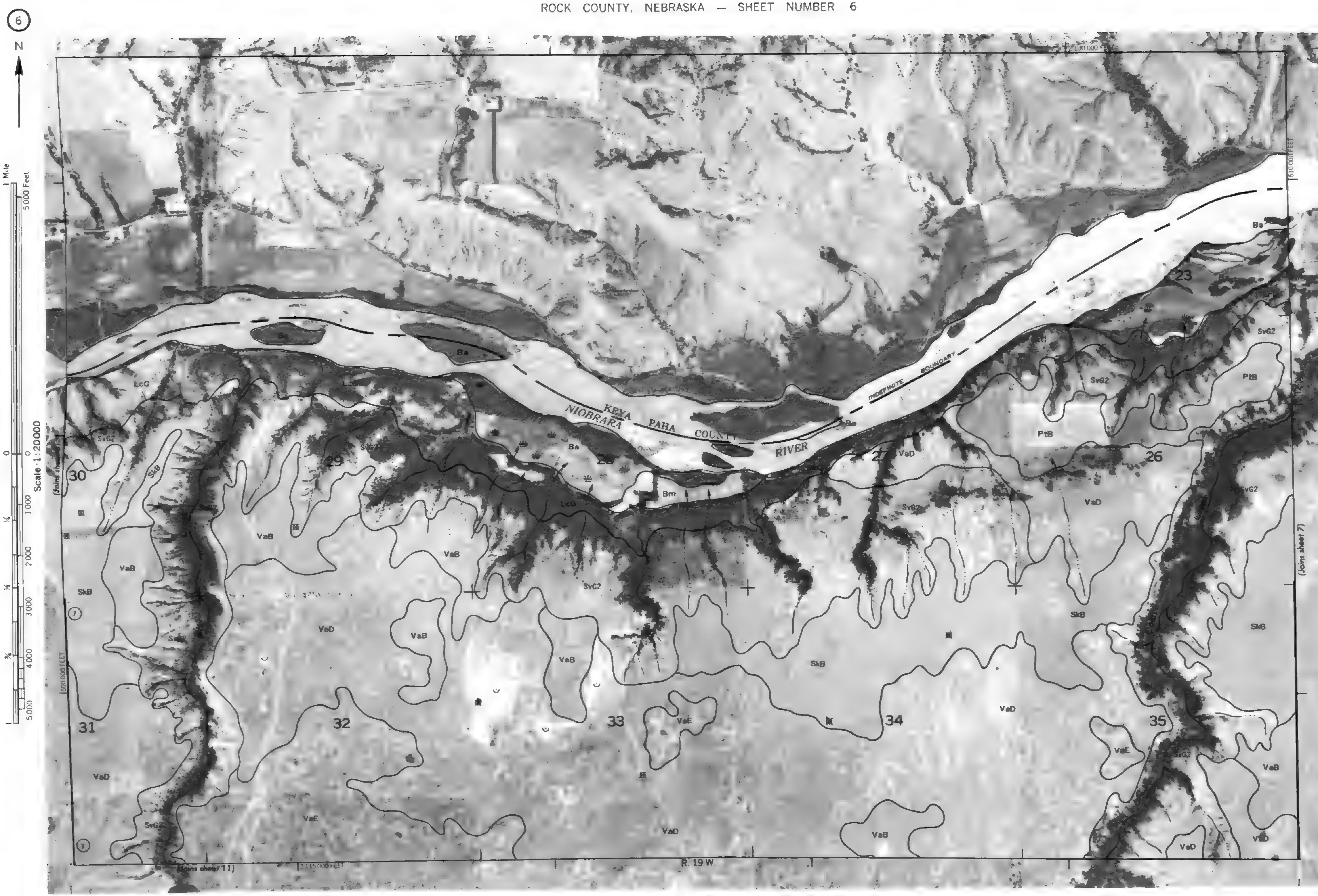
ROCK COUNTY, NEBRASKA NO. 5





ROCK COUNTY, NEBRASKA NO. 6

ROCK COUNTY, NEBRASKA — SHEET NUMBER 7

ROCK COUNTY, NEBRASKA NO. 7

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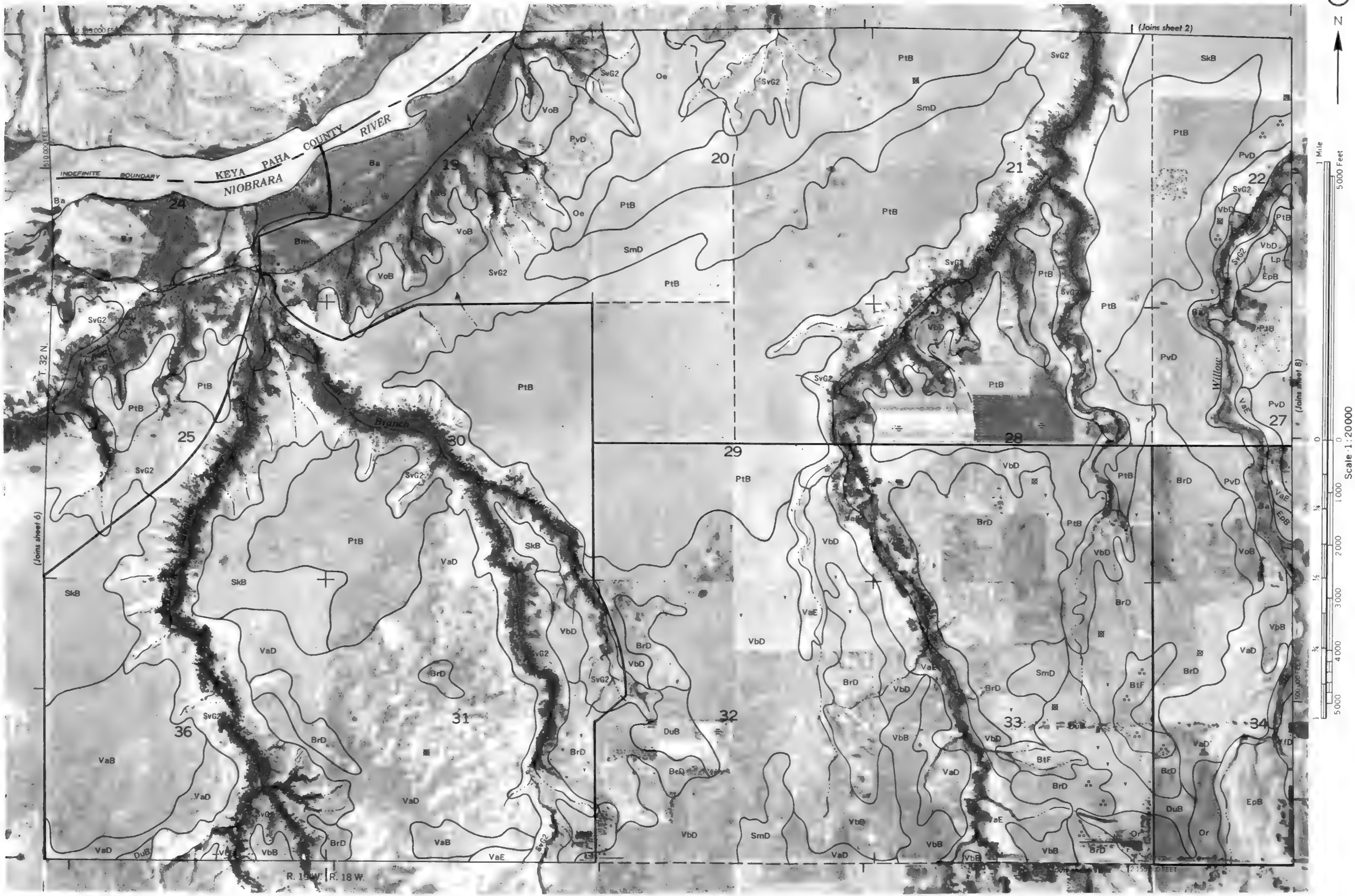
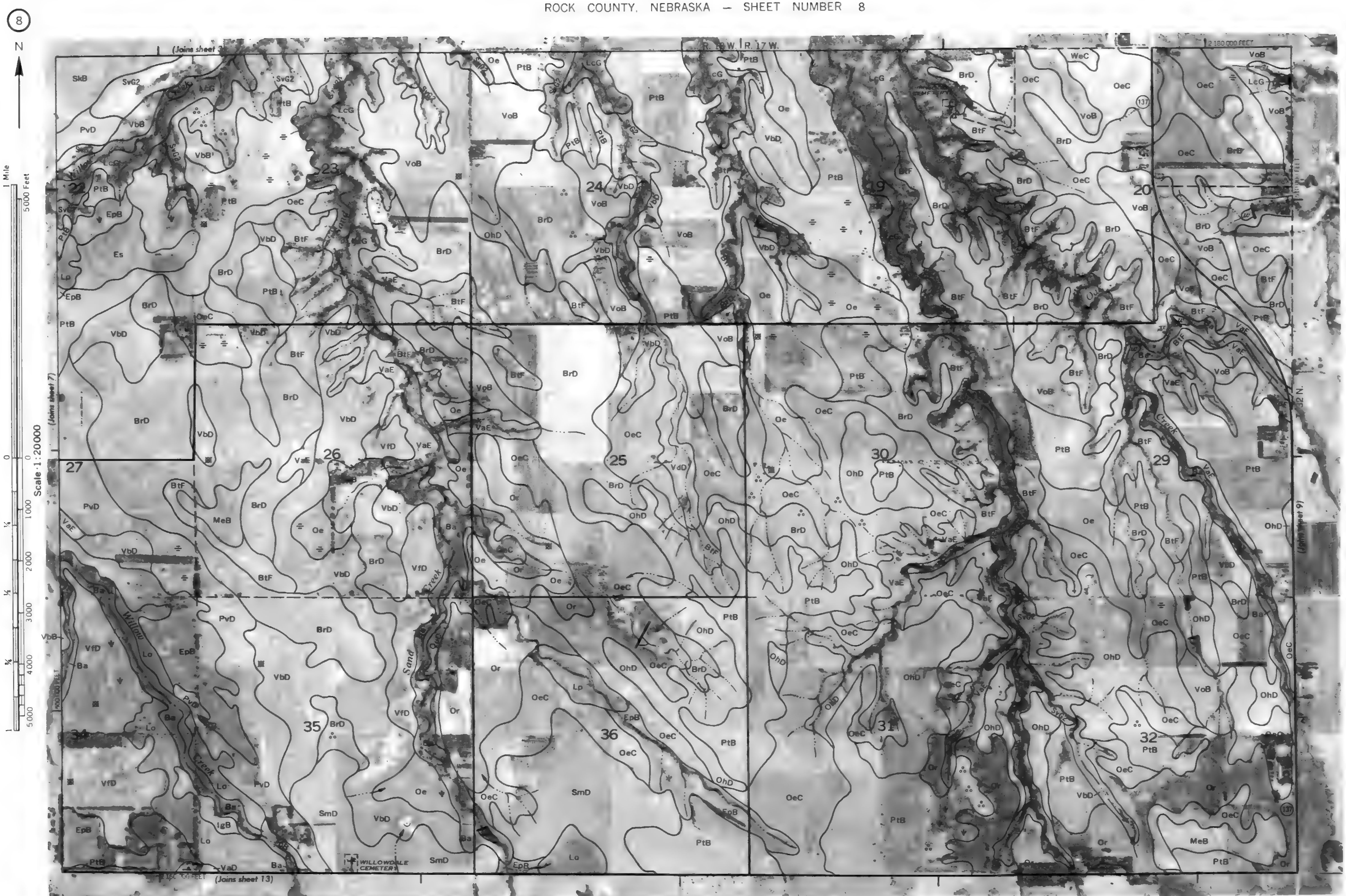
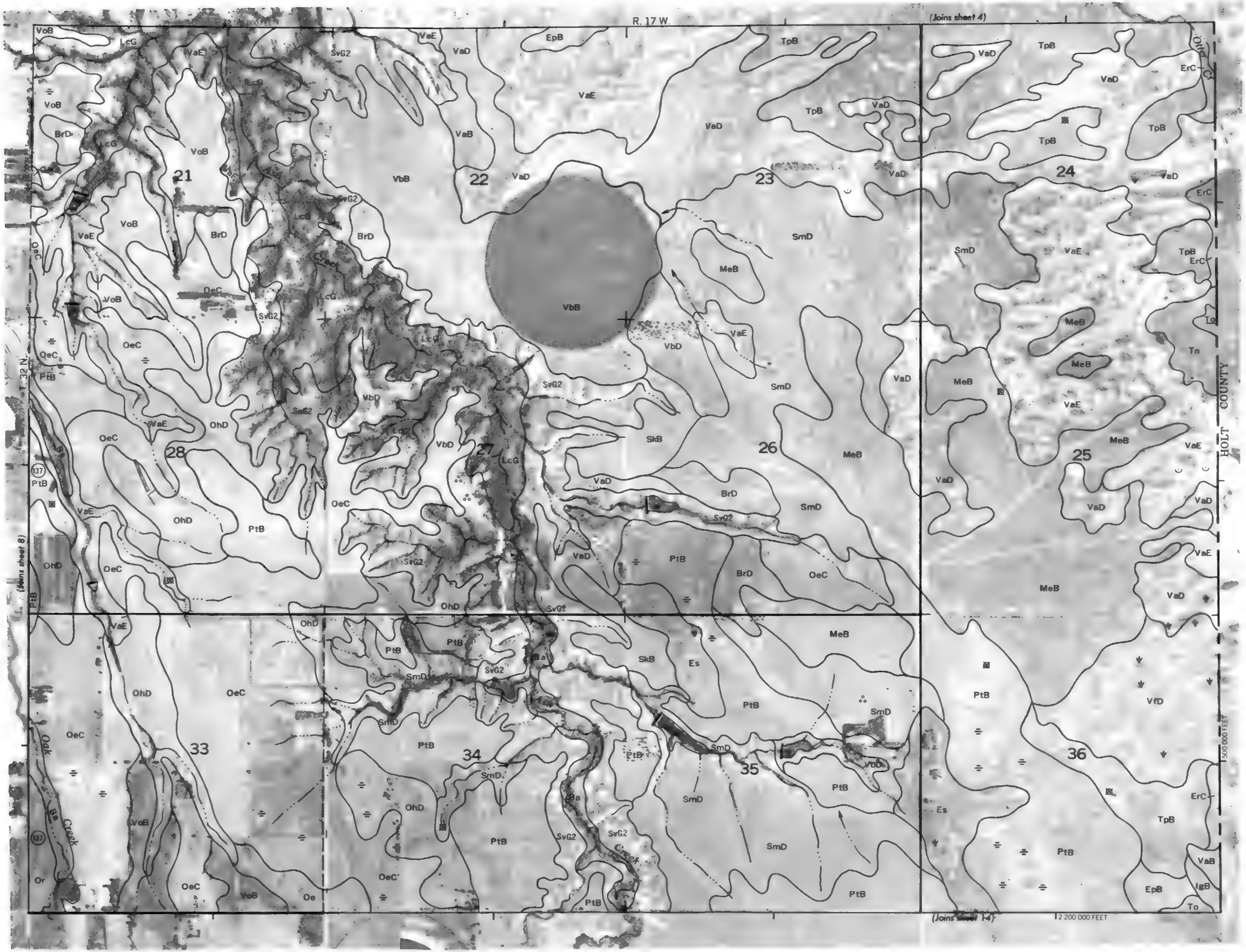
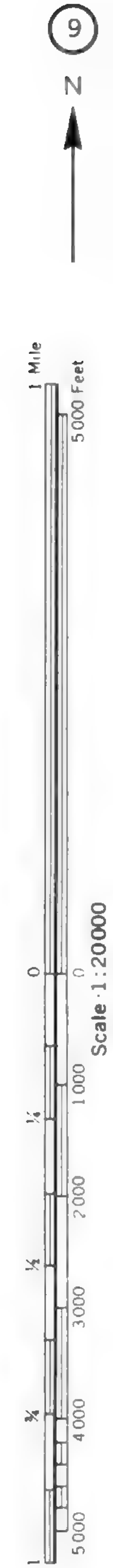




ROCK COUNTY, NEBRASKA NO. 8

9





ROCK COUNTY, NEBRASKA NO. 9

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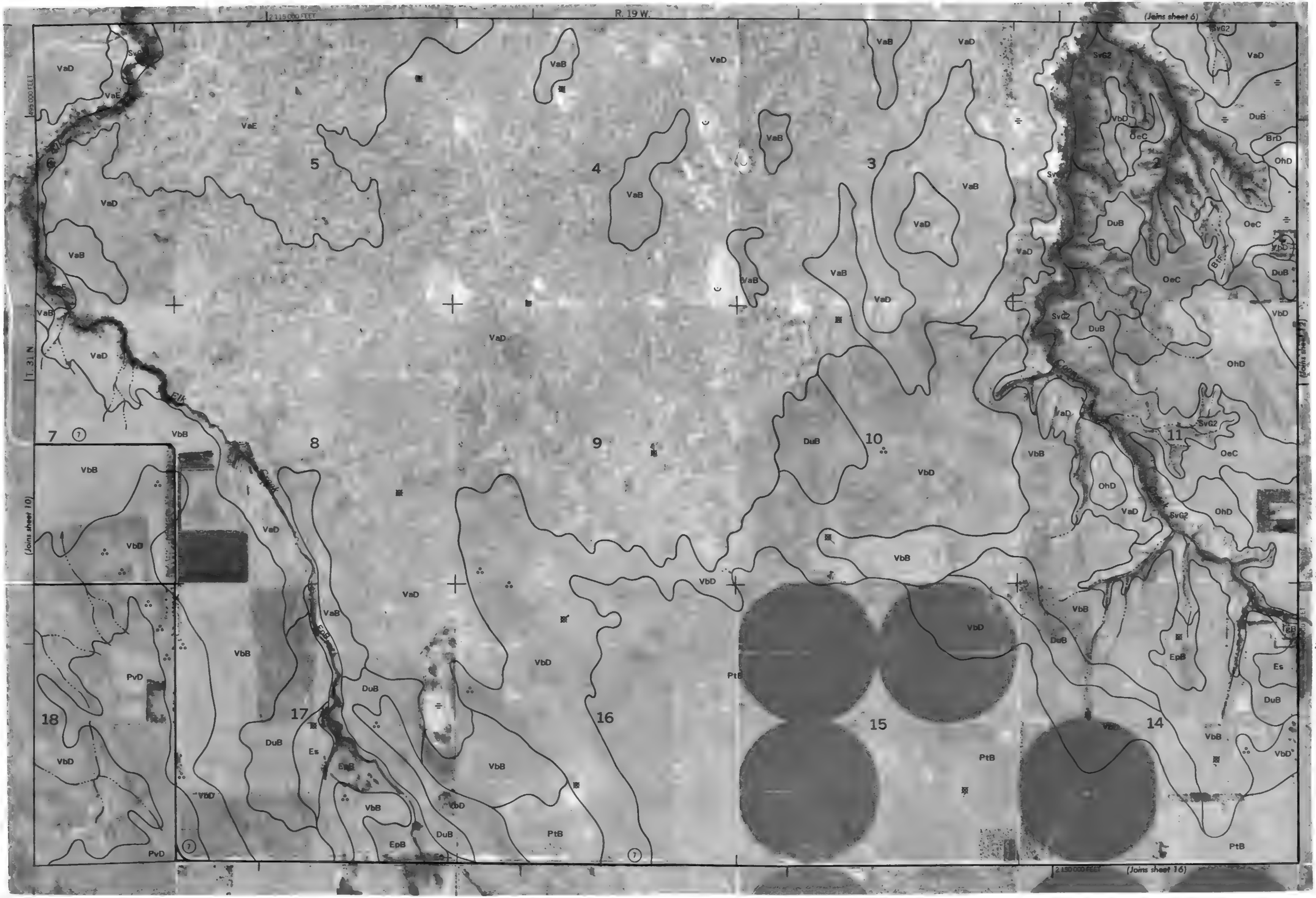
11



N

Scale 1:20000

1 Mile

5000 Feet

0 1000 2000 3000 4000 5000

0 ¼ ½ ¾ 1

ROCK COUNTY, NEBRASKA NO. 11

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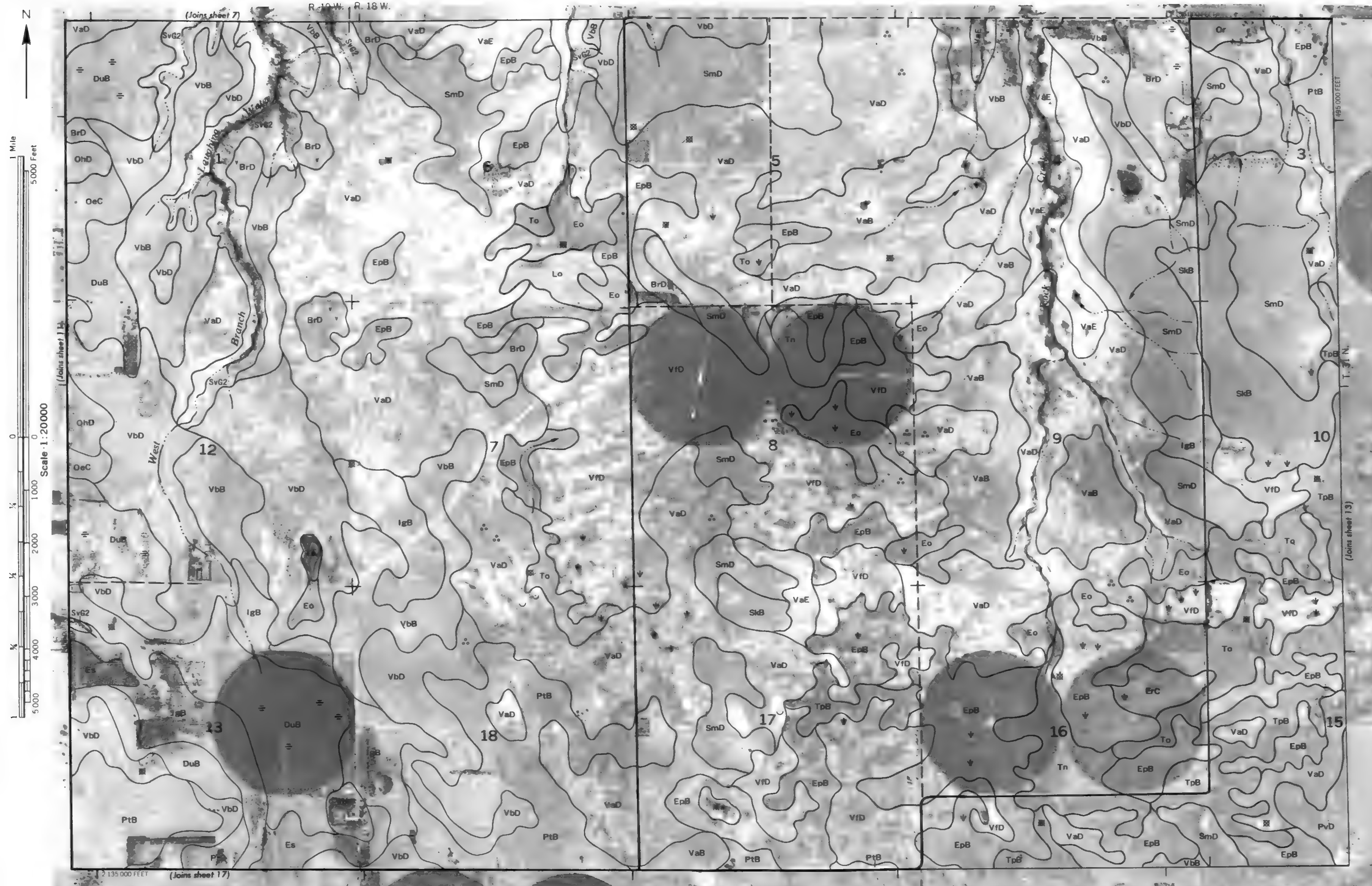
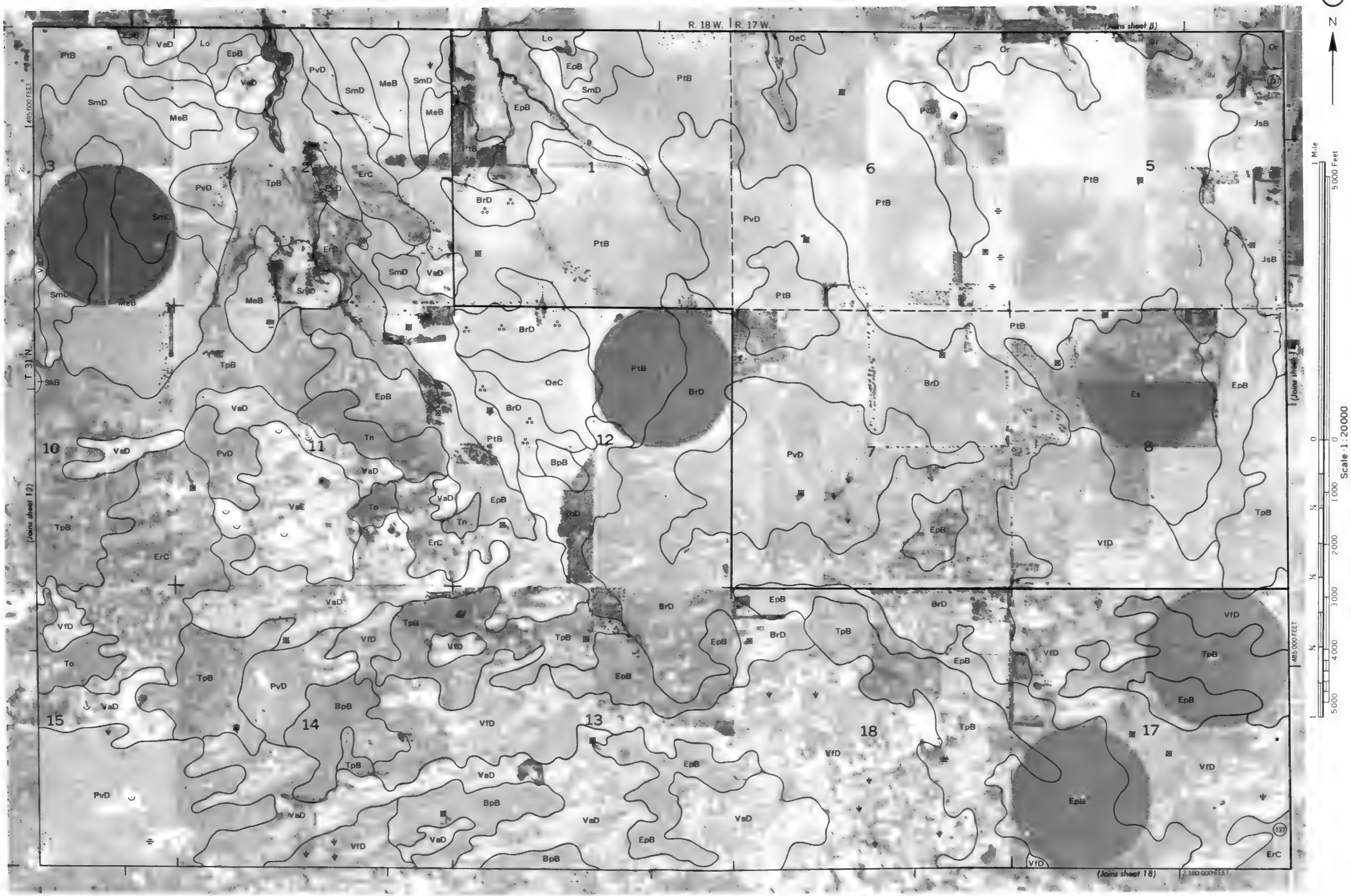
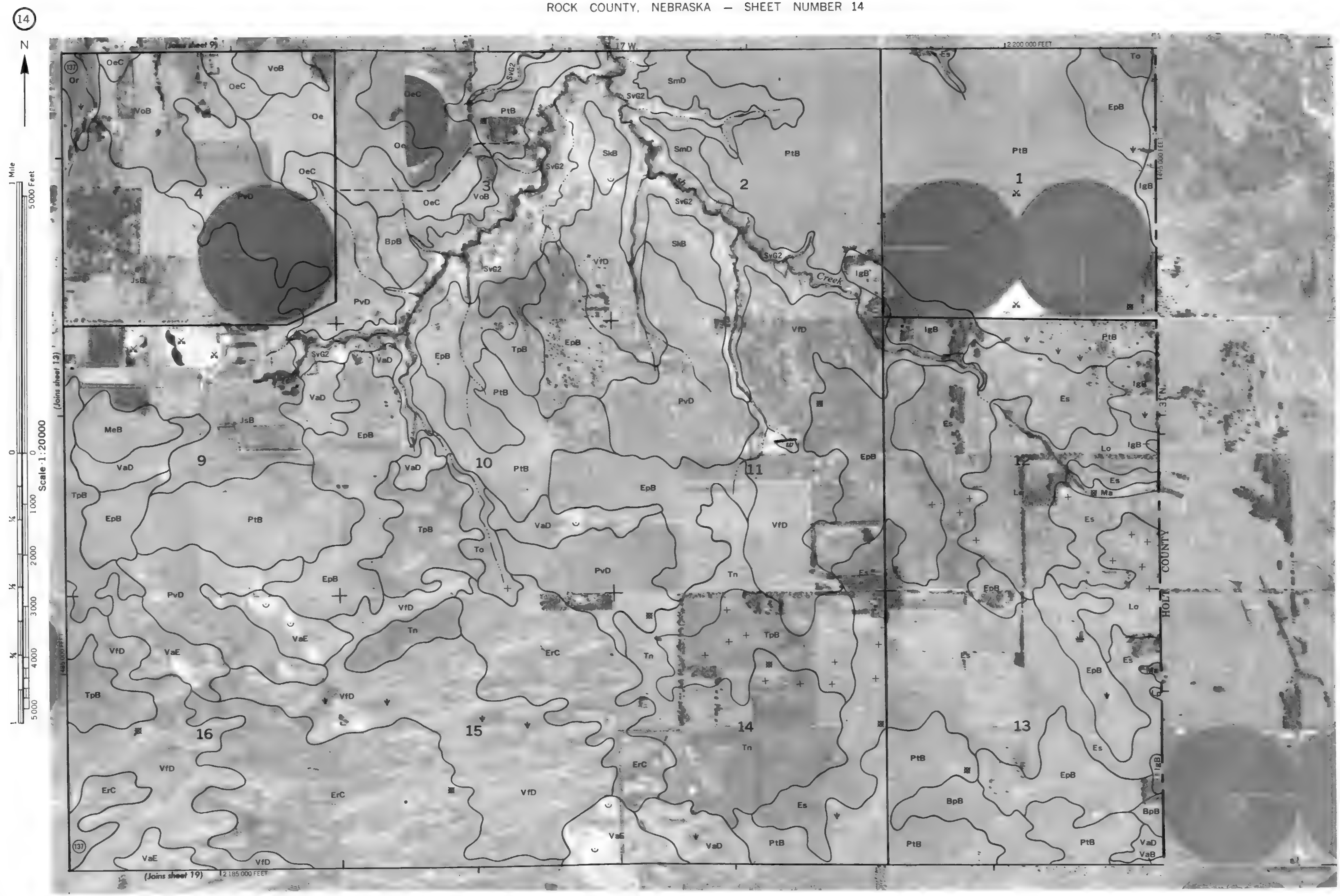

N
(Joins sheet 7)
R. 19 W.
R. 18 W.
(Joins sheet 11)
(Joins sheet 13)
(Joins sheet 17)
495 000 FEET
2 135 000 FEET
T. 31 N.
Scale 1:20000
1 Mile
5000 Feet
Laughing Water
West Branch
Rock Creek
1
3
5
6
7
8
9
10
12
13
15
16
17
18

ROCK COUNTY, NEBRASKA NO. 13





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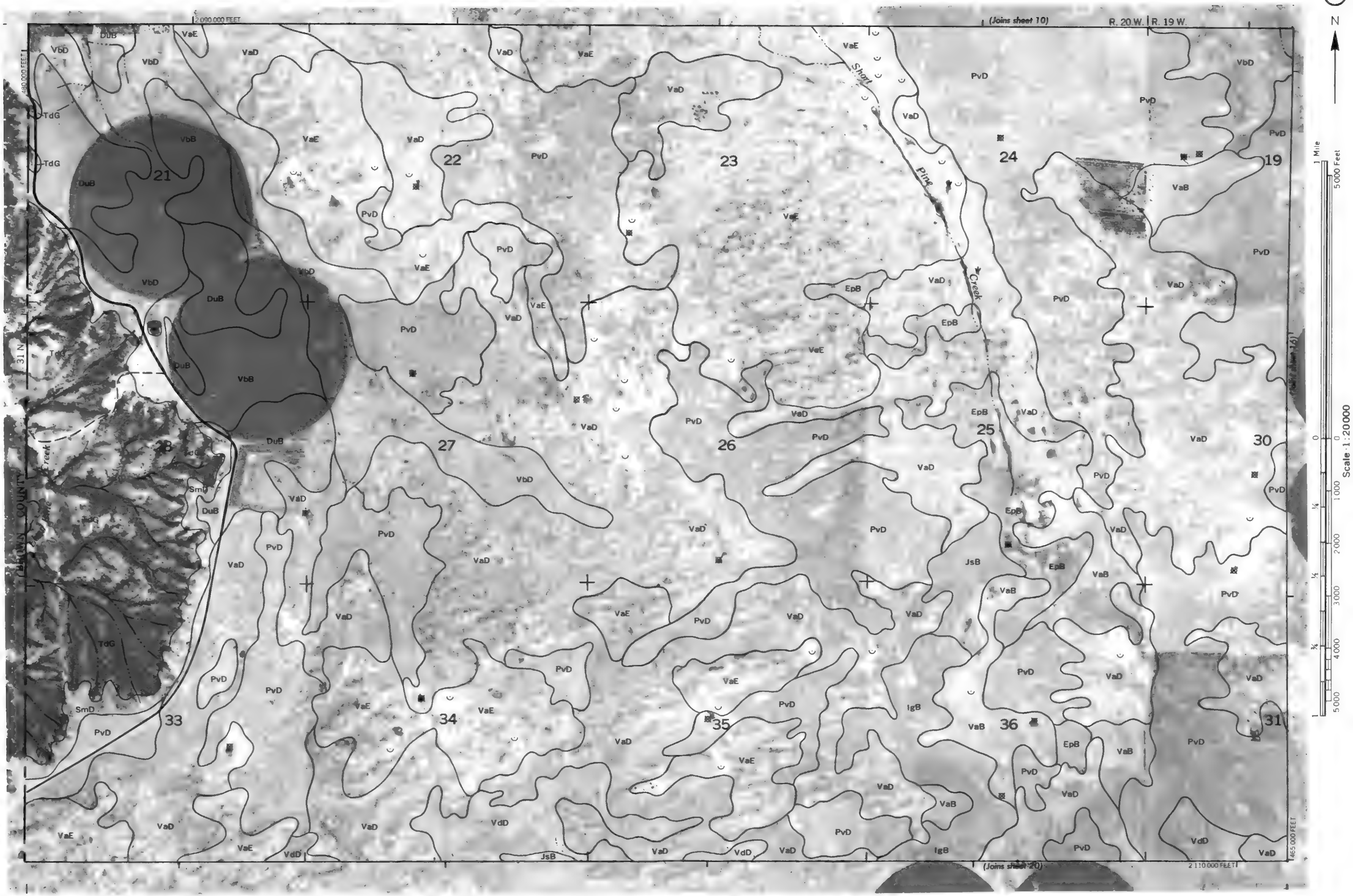
ROCK COUNTY, NEBRASKA NO. 15



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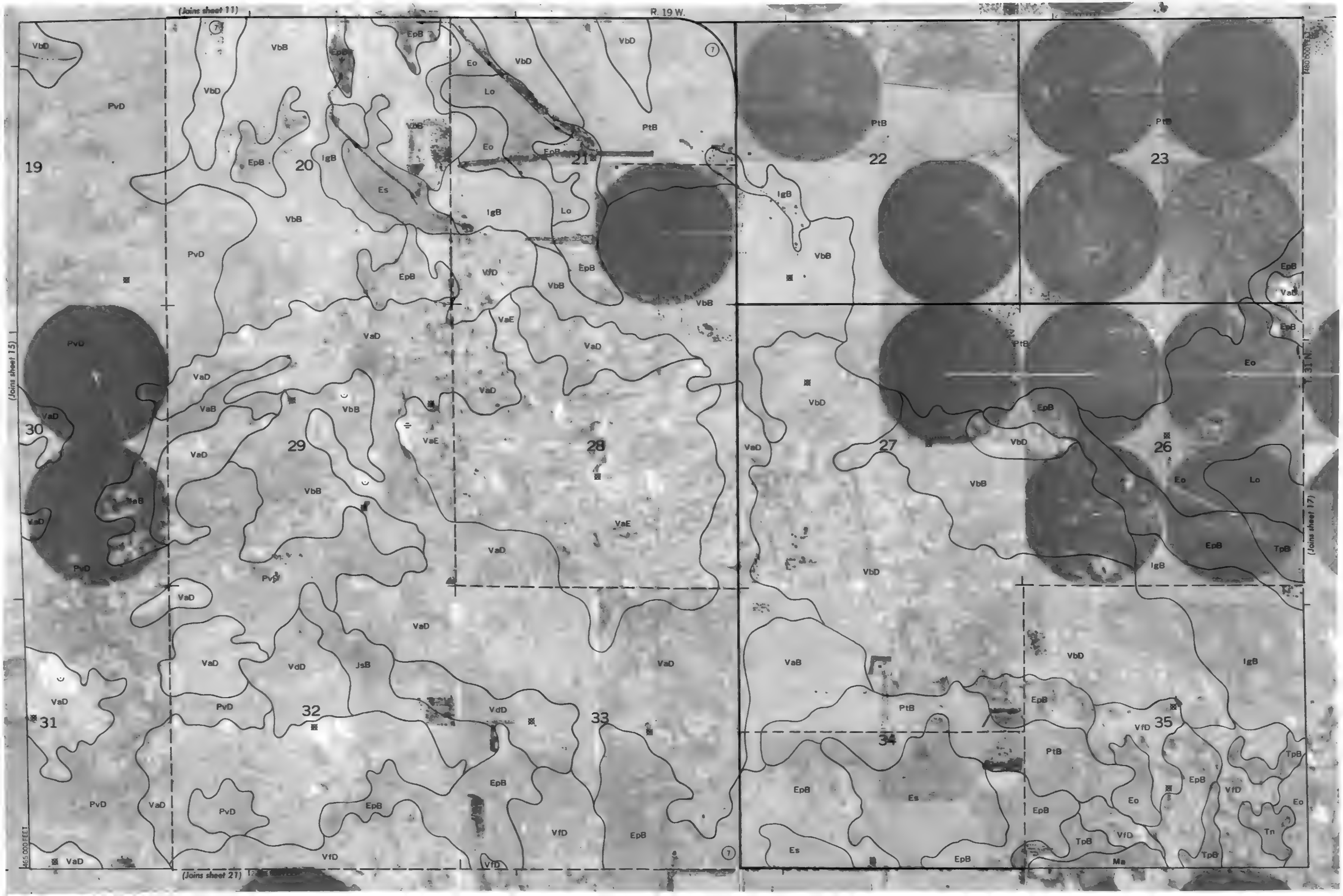

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ROCK COUNTY, NEBRASKA NO. 16

ROCK COUNTY, NEBRASKA NO. 17

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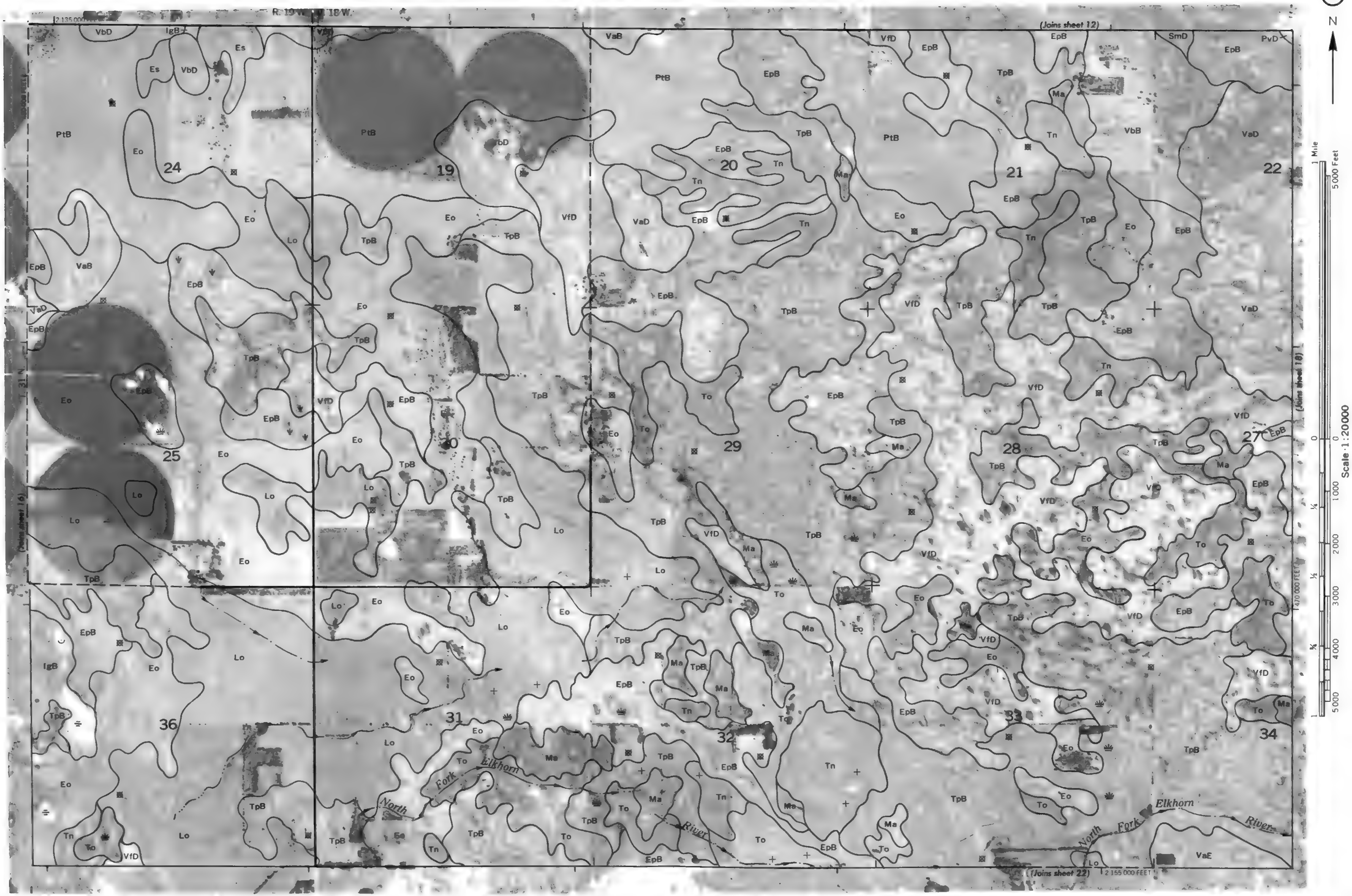
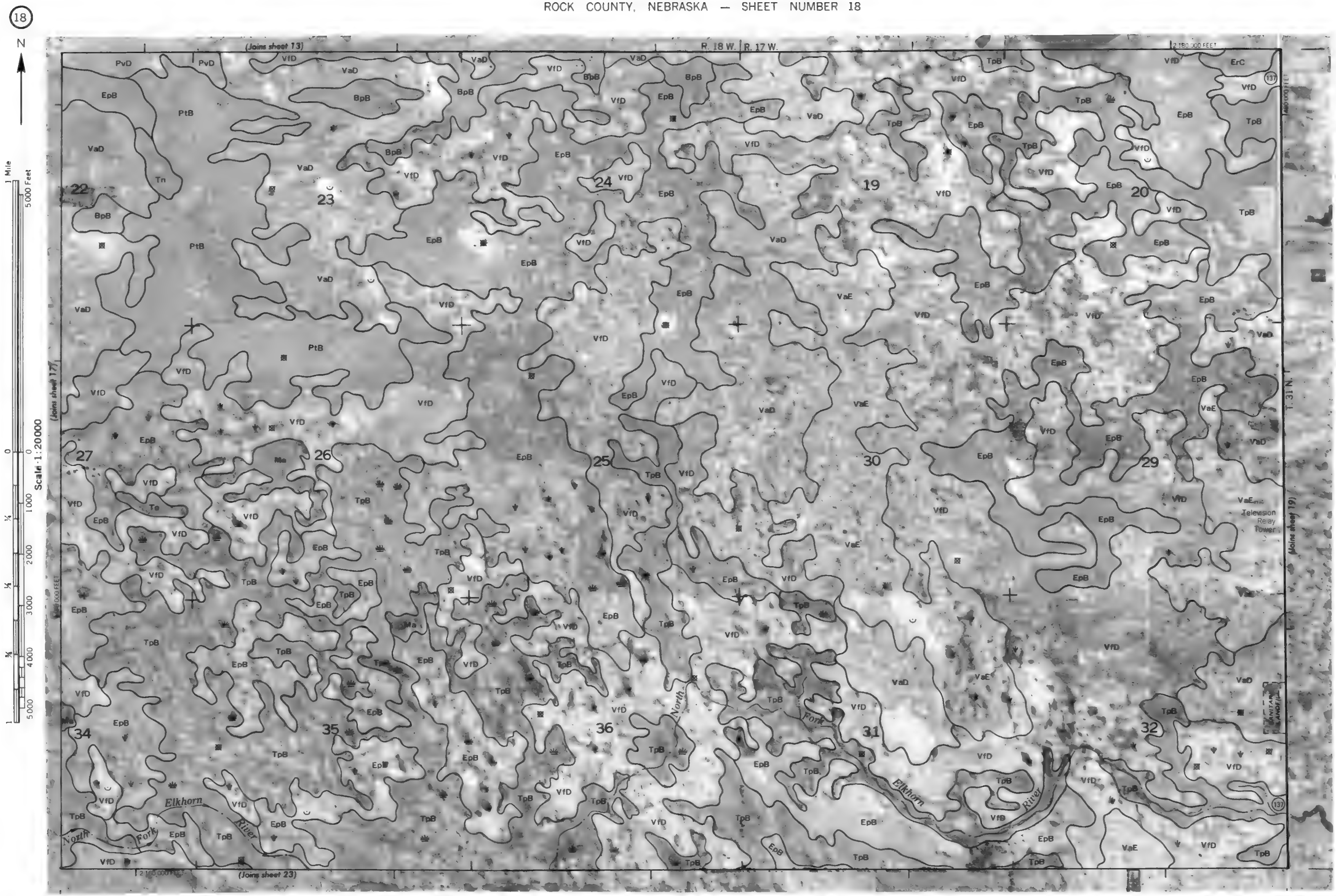
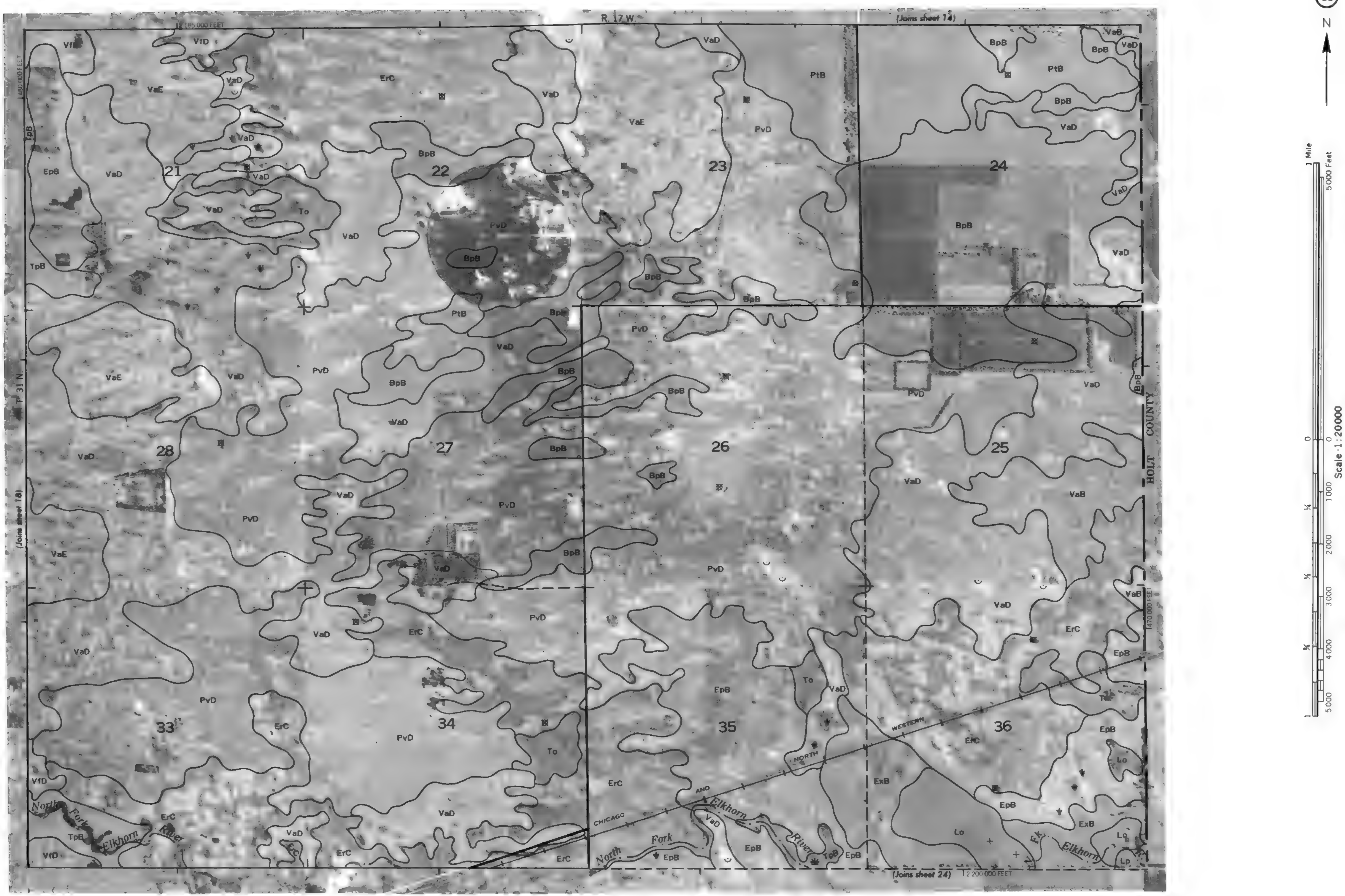
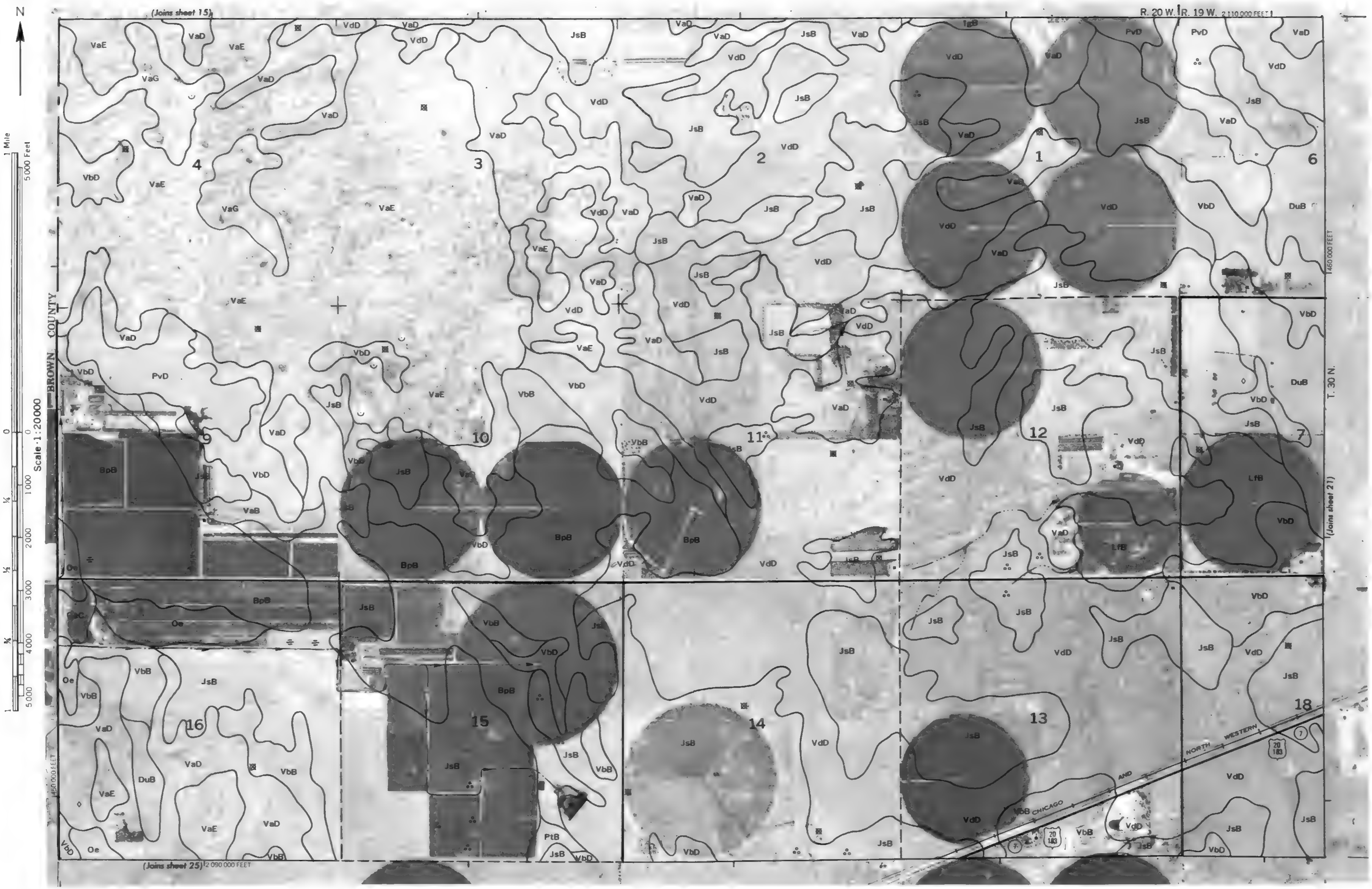




ROCK COUNTY, NEBRASKA NO. 18

ROCK COUNTY, NEBRASKA NO. 19





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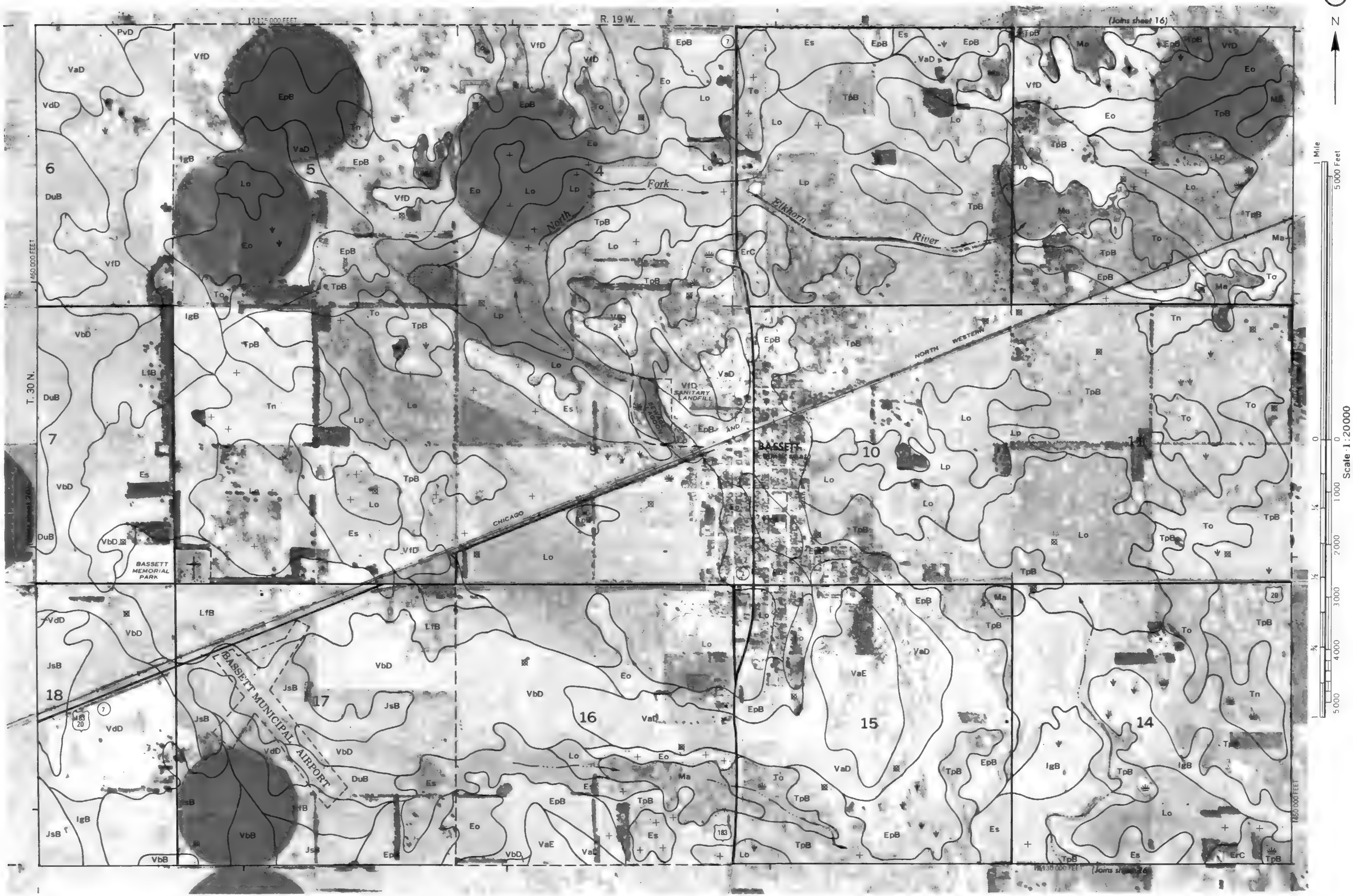
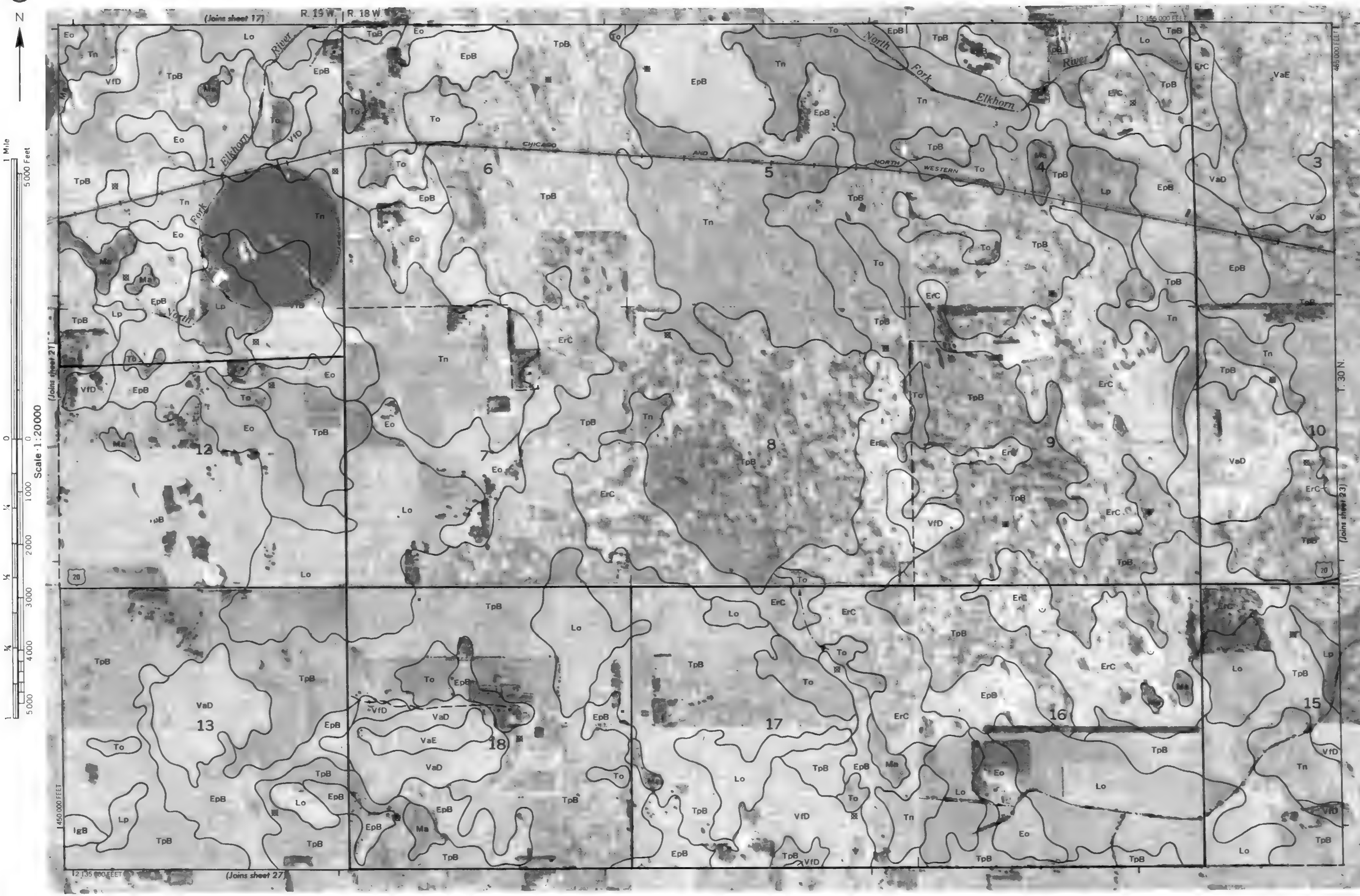
ROCK COUNTY, NEBRASKA NO. 20

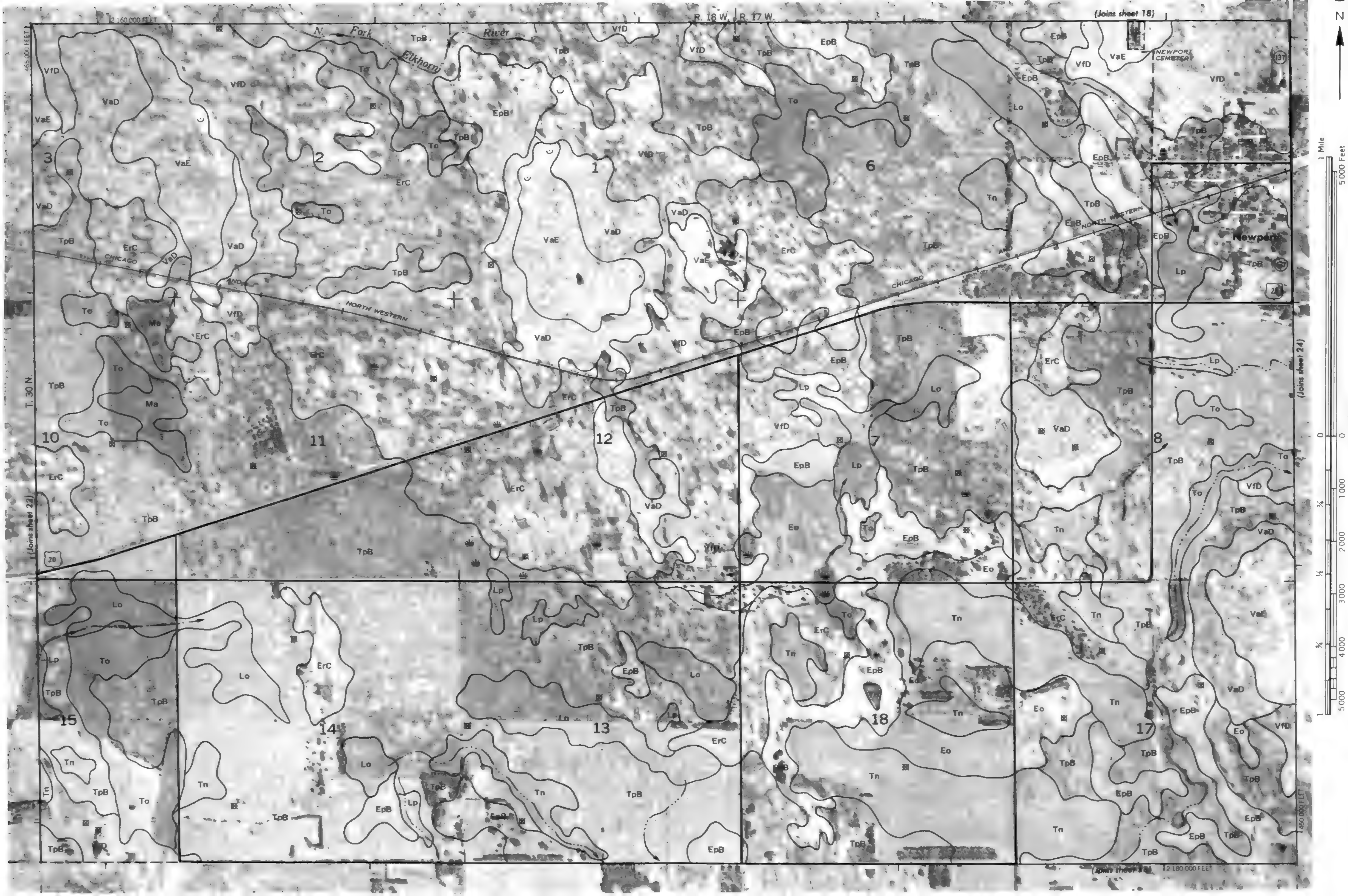


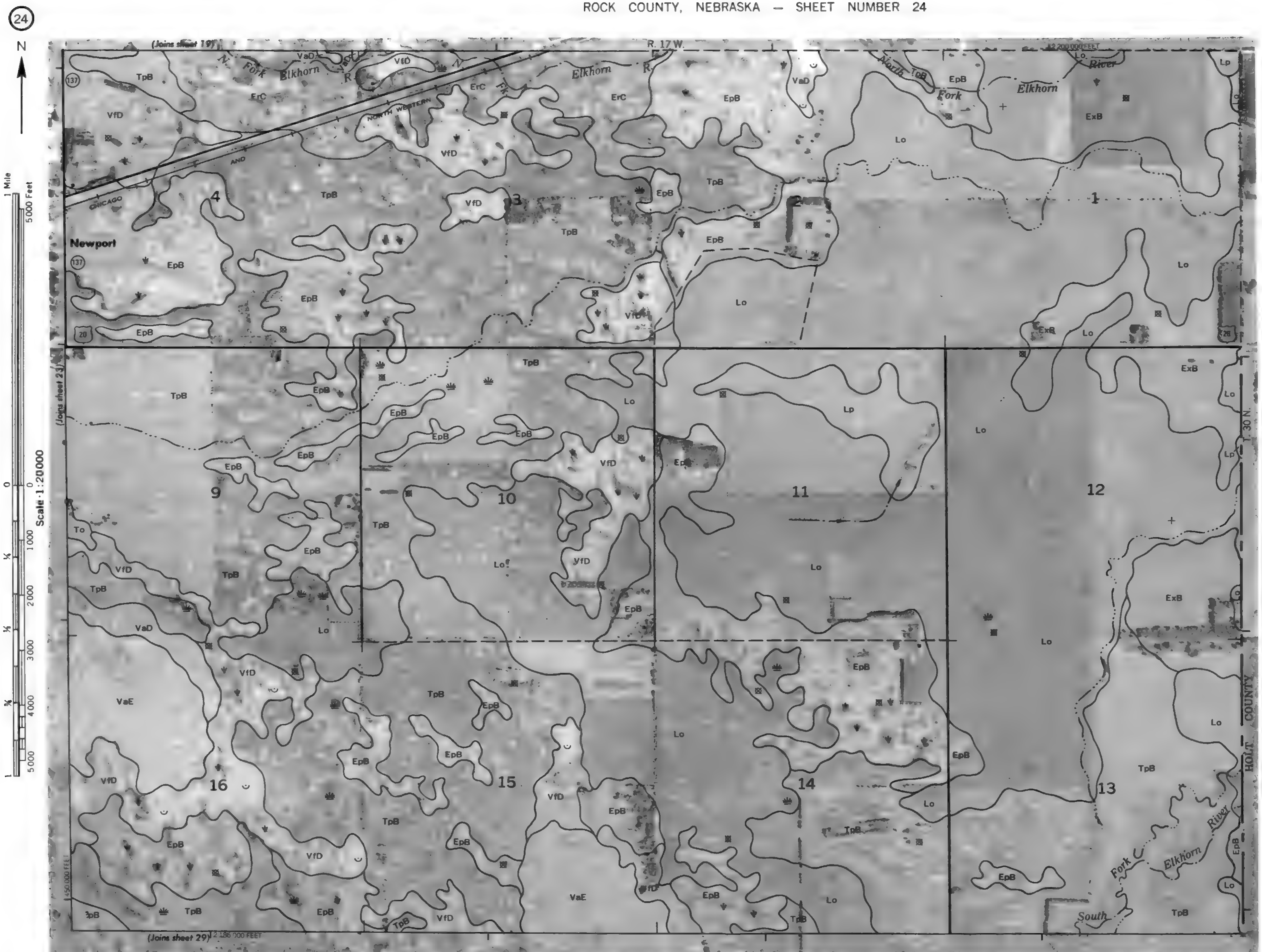
ROCK COUNTY, NEBRASKA NO. 21



ROCK COUNTY, NEBRASKA NO. 22

ROCK COUNTY, NEBRASKA NO. 23





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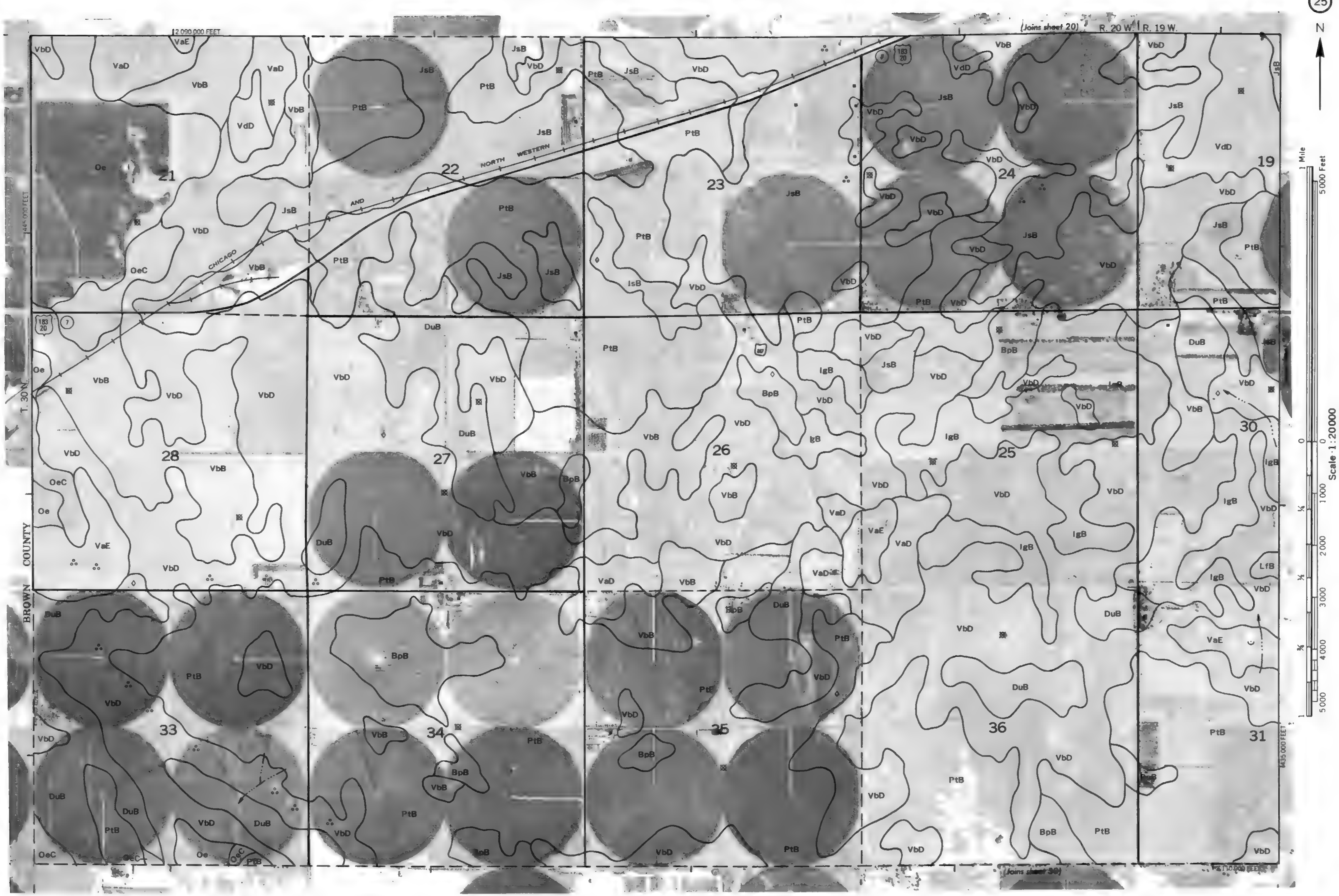

ROCK COUNTY, NEBRASKA NO. 25

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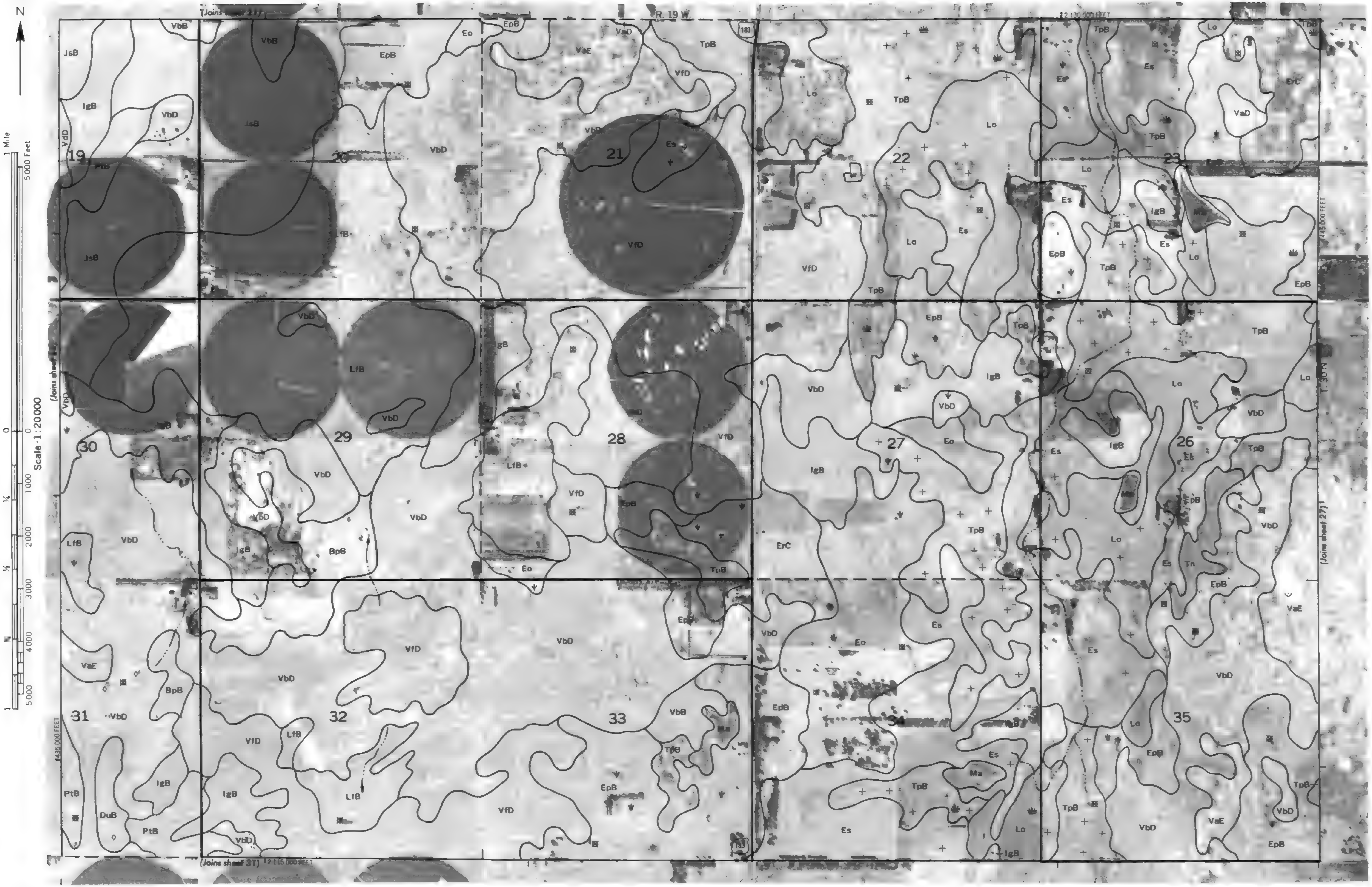
26
N
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
(Joins sheet 21)
(Joins sheet 27)
(Joins sheet 37)
R. 19 W.
T. 30 N.
2 130 000 FEET
2 115 000 FEET
435 000 FEET
183
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35
VbB
JsB
IgB
VbD
VdD
PtB
LfB
Eo
EpB
VaD
VaE
TpB
VfD
Es
Lo
ErC
BpB
Ma
DuB
Tn

ROCK COUNTY, NEBRASKA NO. 27

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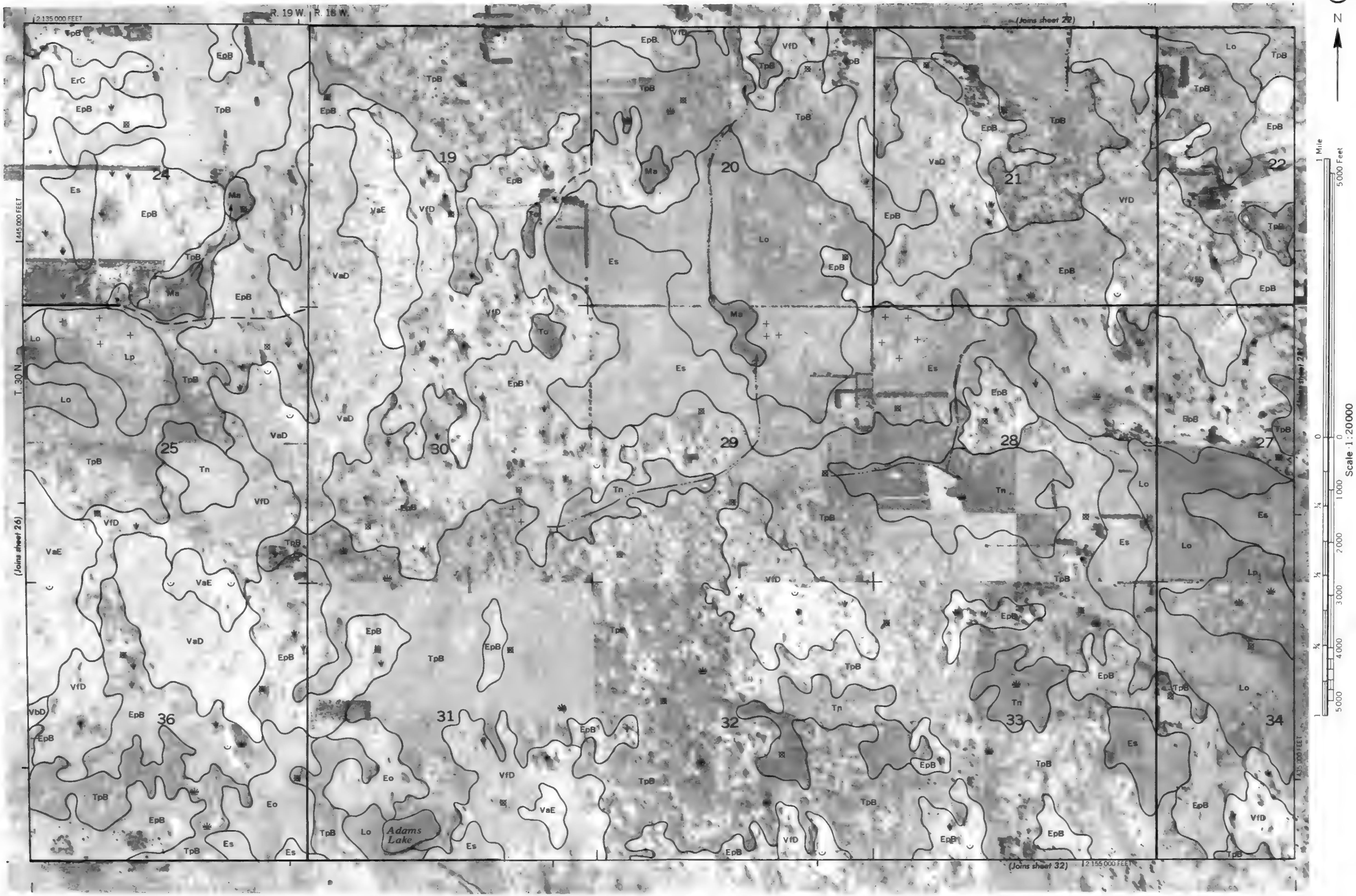
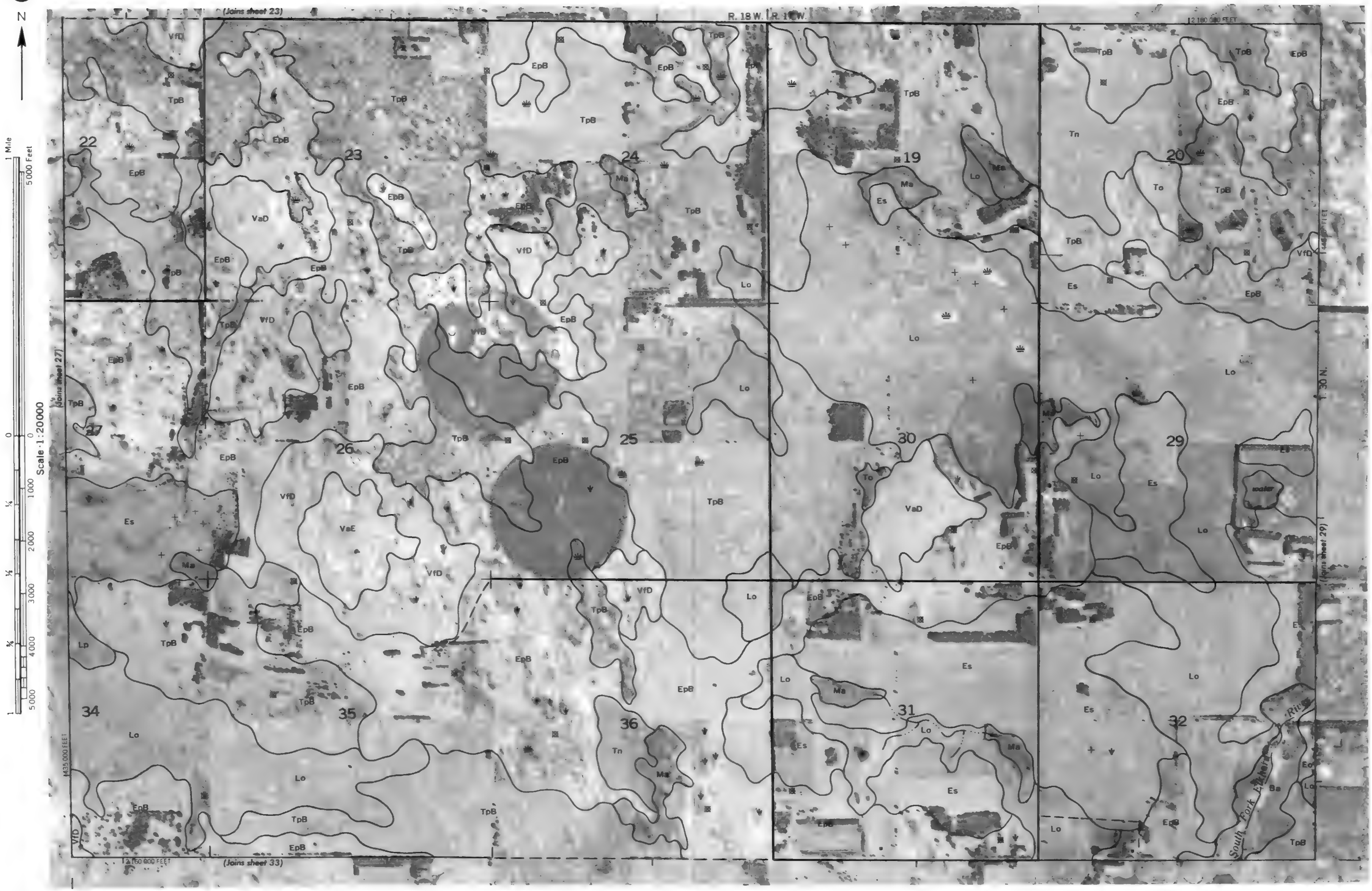
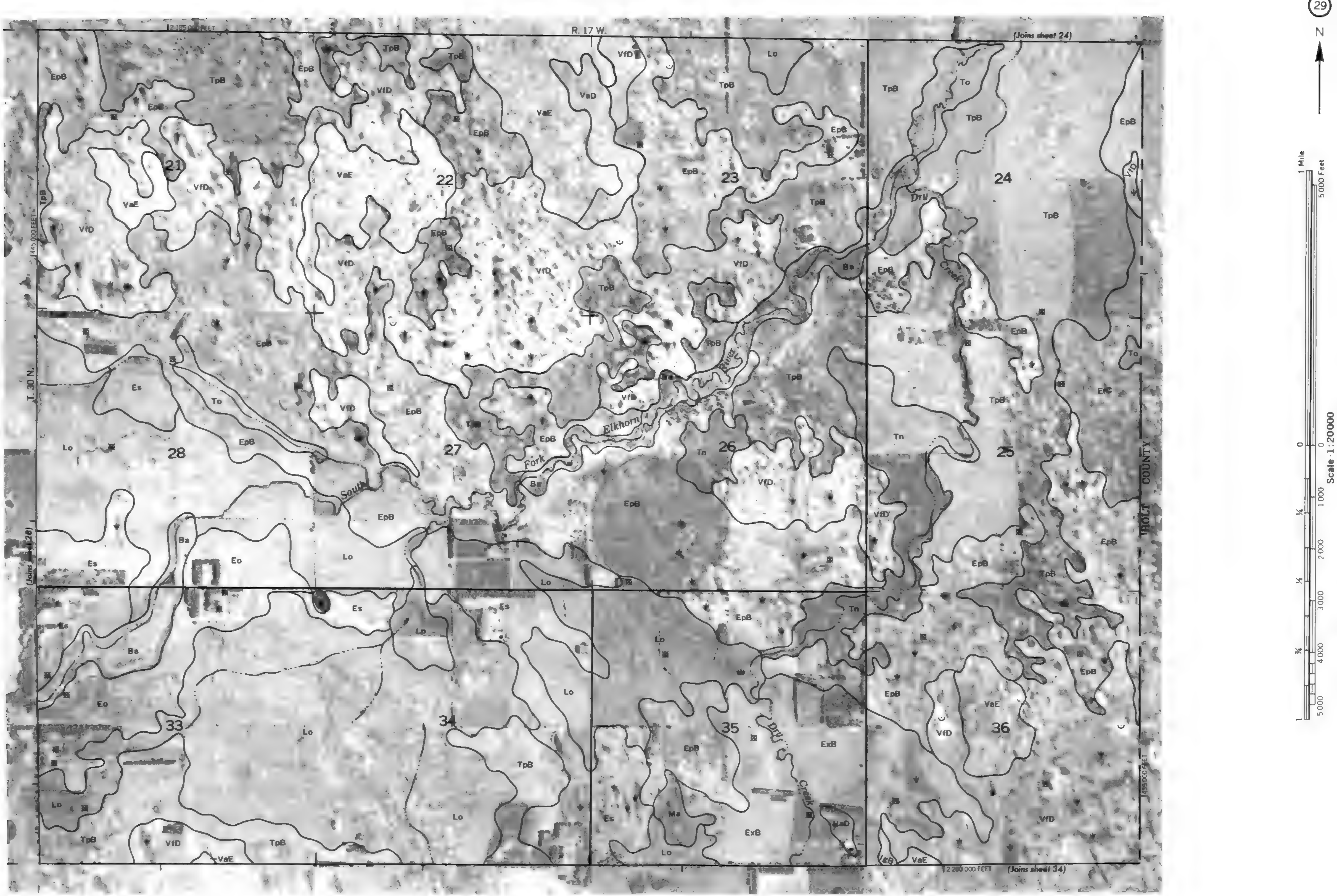




ROCK COUNTY, NEBRASKA NO. 28



ROCK COUNTY, NEBRASKA NO. 29

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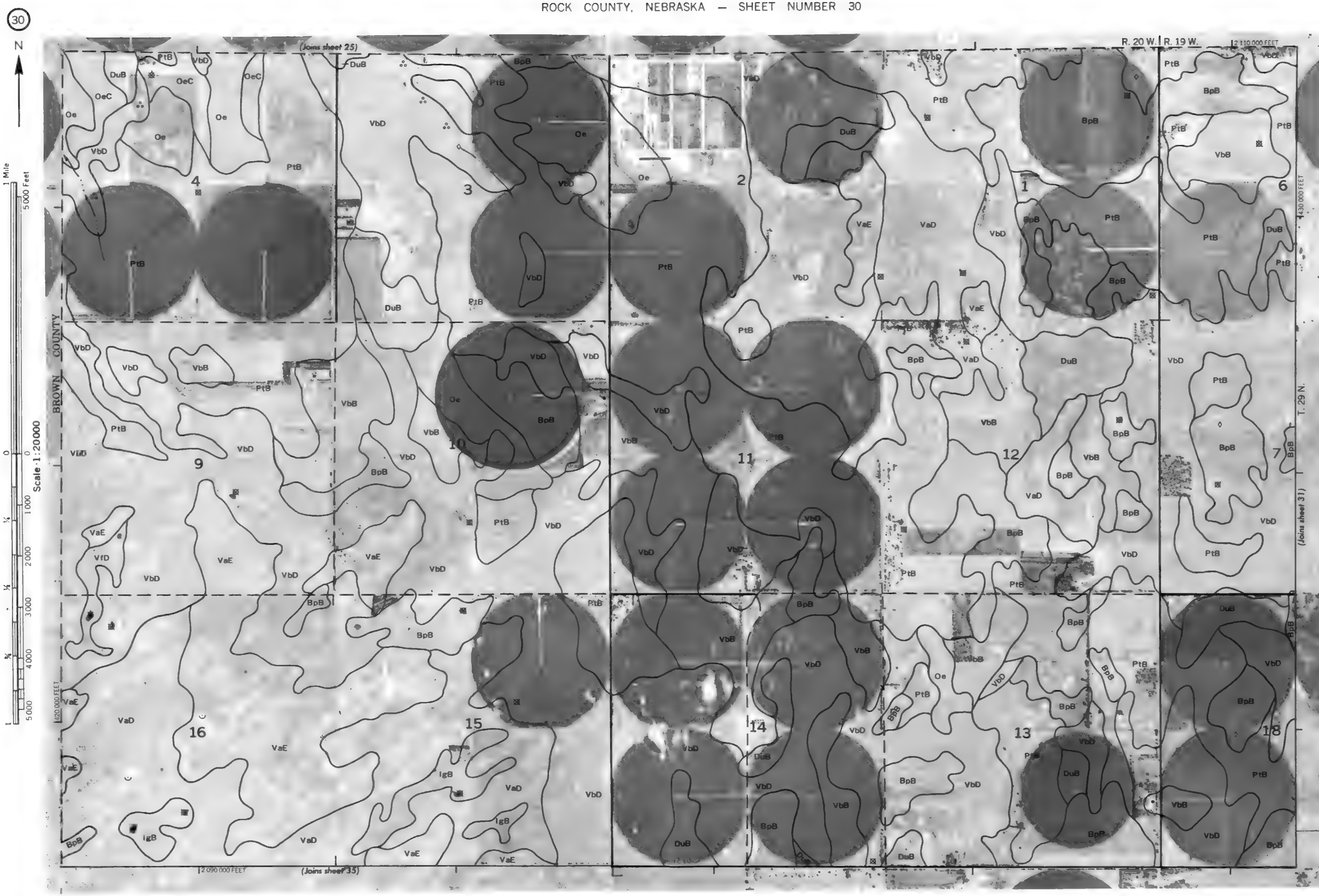

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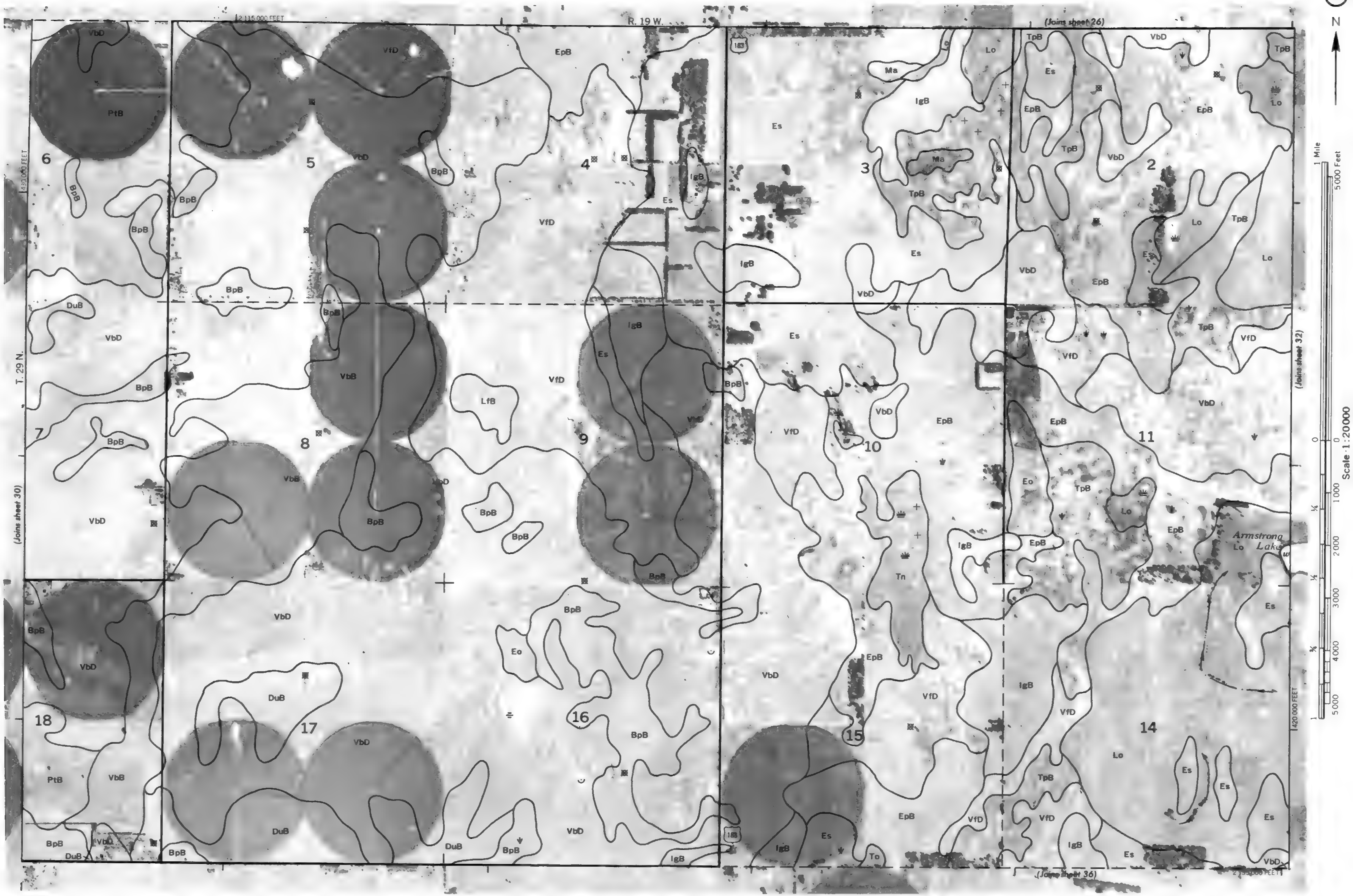
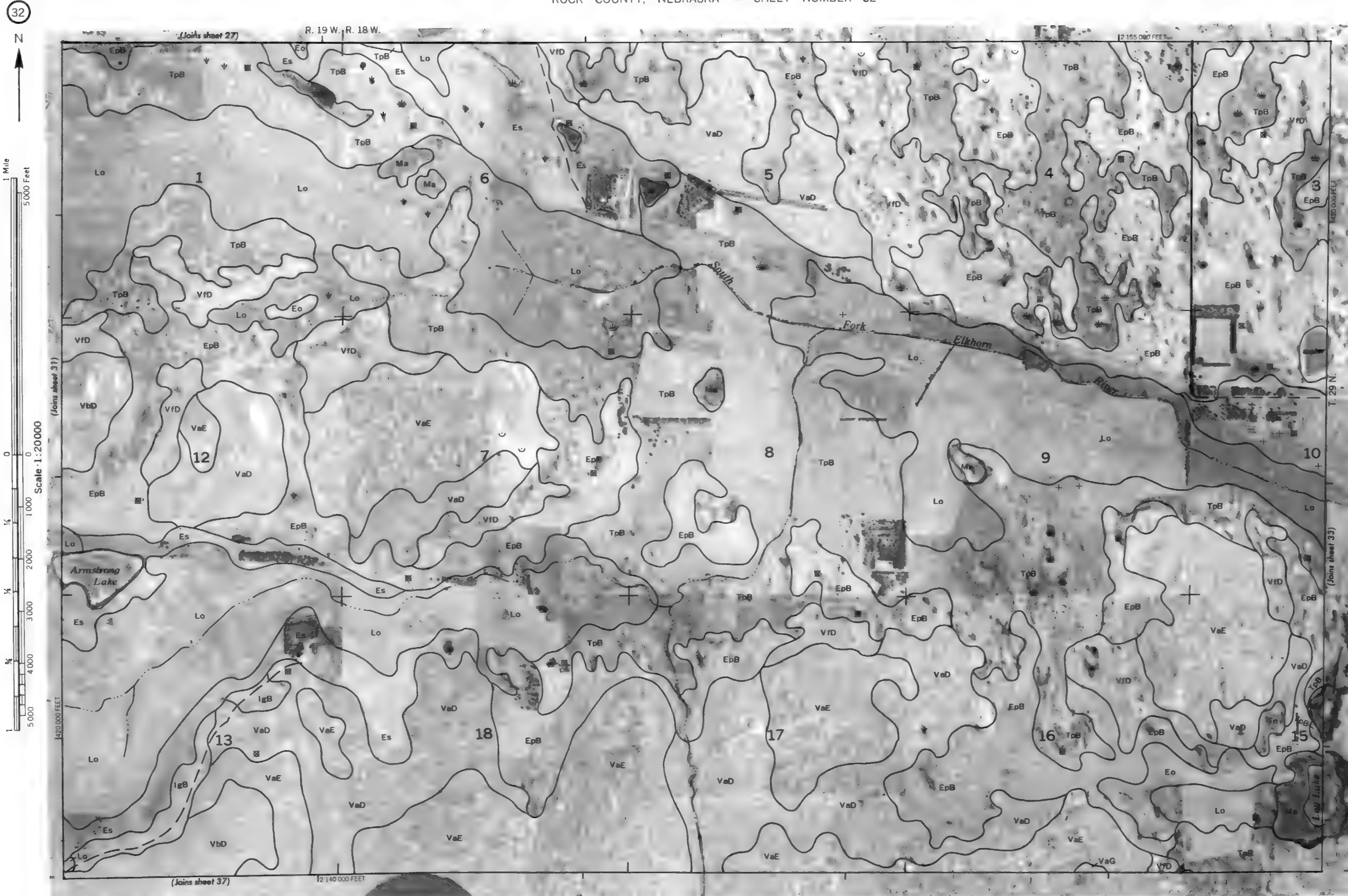
ROCK COUNTY, NEBRASKA NO. 30

31

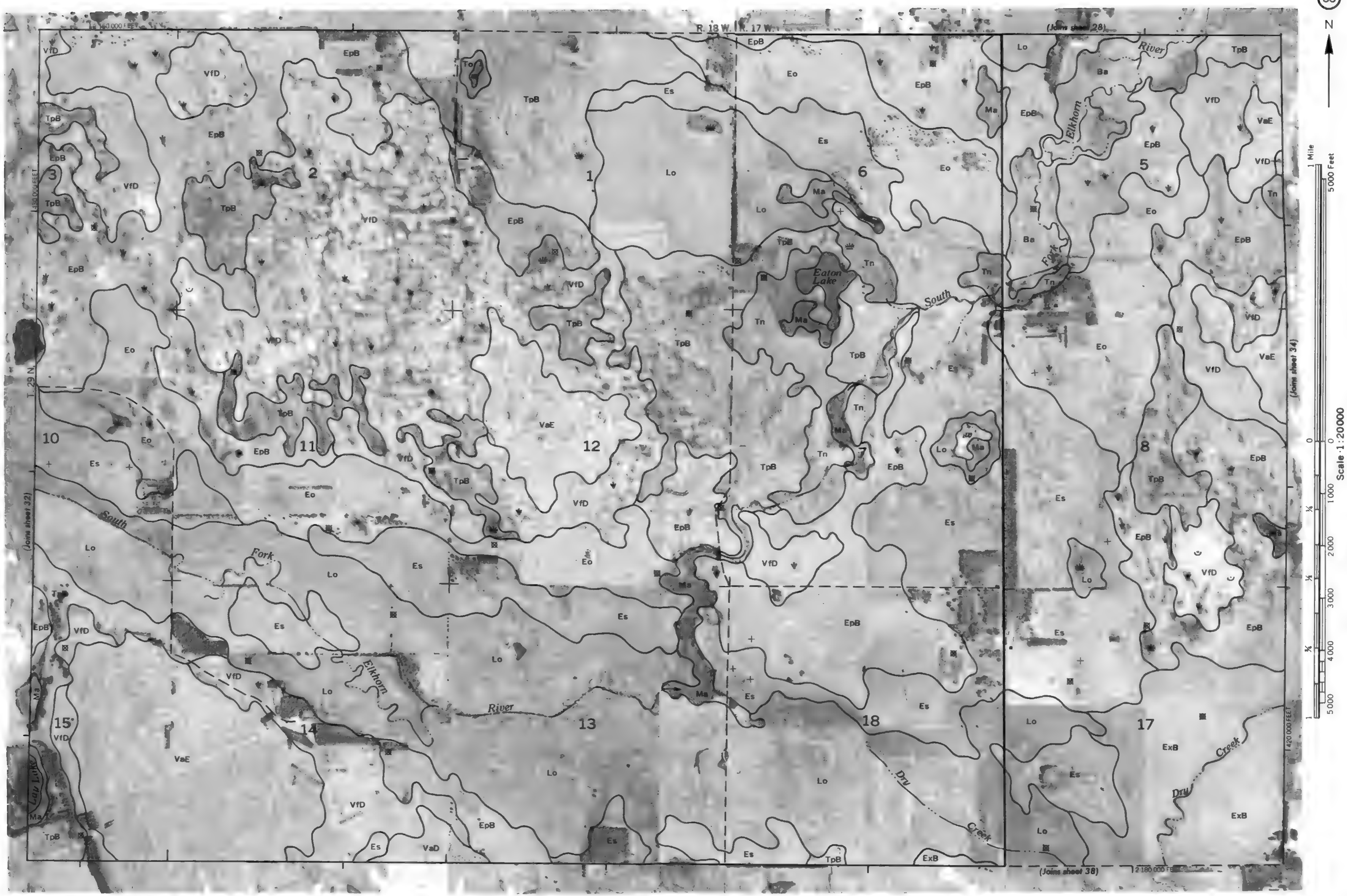
ROCK COUNTY, NEBRASKA NO. 31

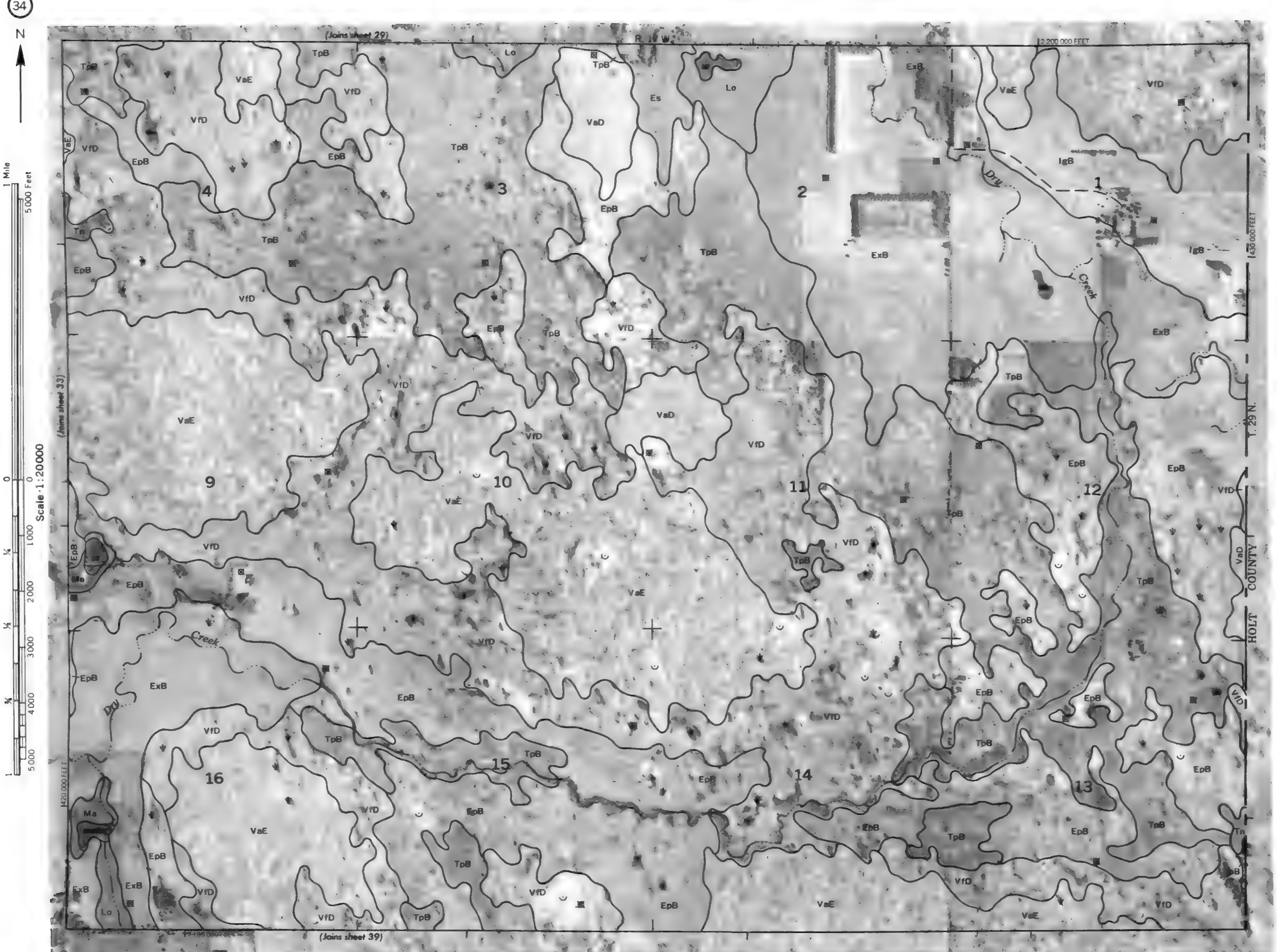




This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

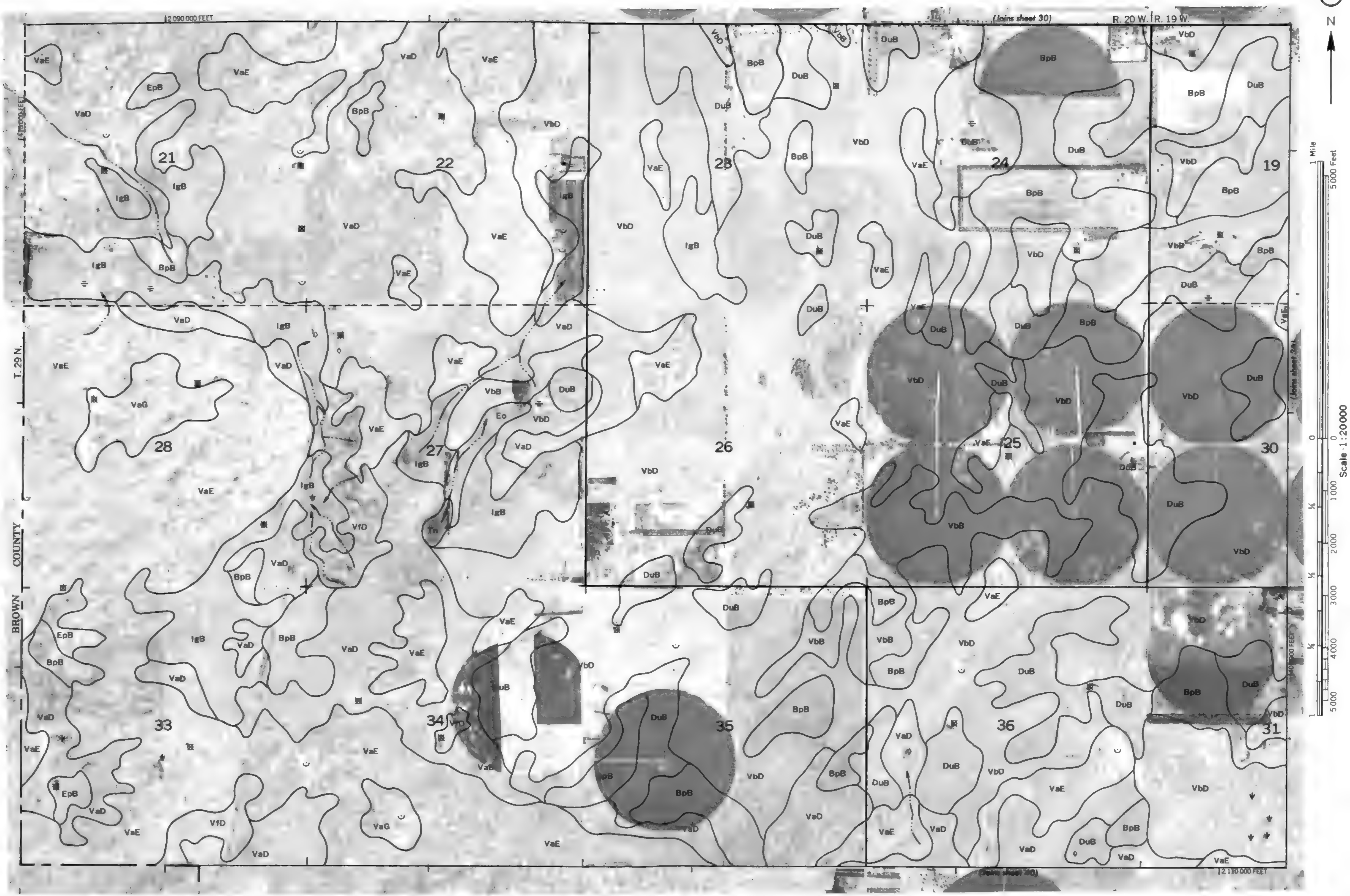
ROCK COUNTY, NEBRASKA NO. 32


33
N
R. 18 W.
R. 17 W.
(Joins sheet 28)
(Joins sheet 32)
(Joins sheet 34)
(Joins sheet 38)
T. 29 N.
1 650 000 FEET
420 000 FEET
2 180 000 FEET
Eaton Lake
South Fork
Elkhorn
River
Dry Creek
Scale 1:20000
1 Mile
5000 Feet
1
2
3
5
6
7
8
10
11
12
13
14
15
17
18
Ba
Eo
EpB
Es
ExB
Lo
Ma
Tn
To
TpB
VaD
VaE
VfD



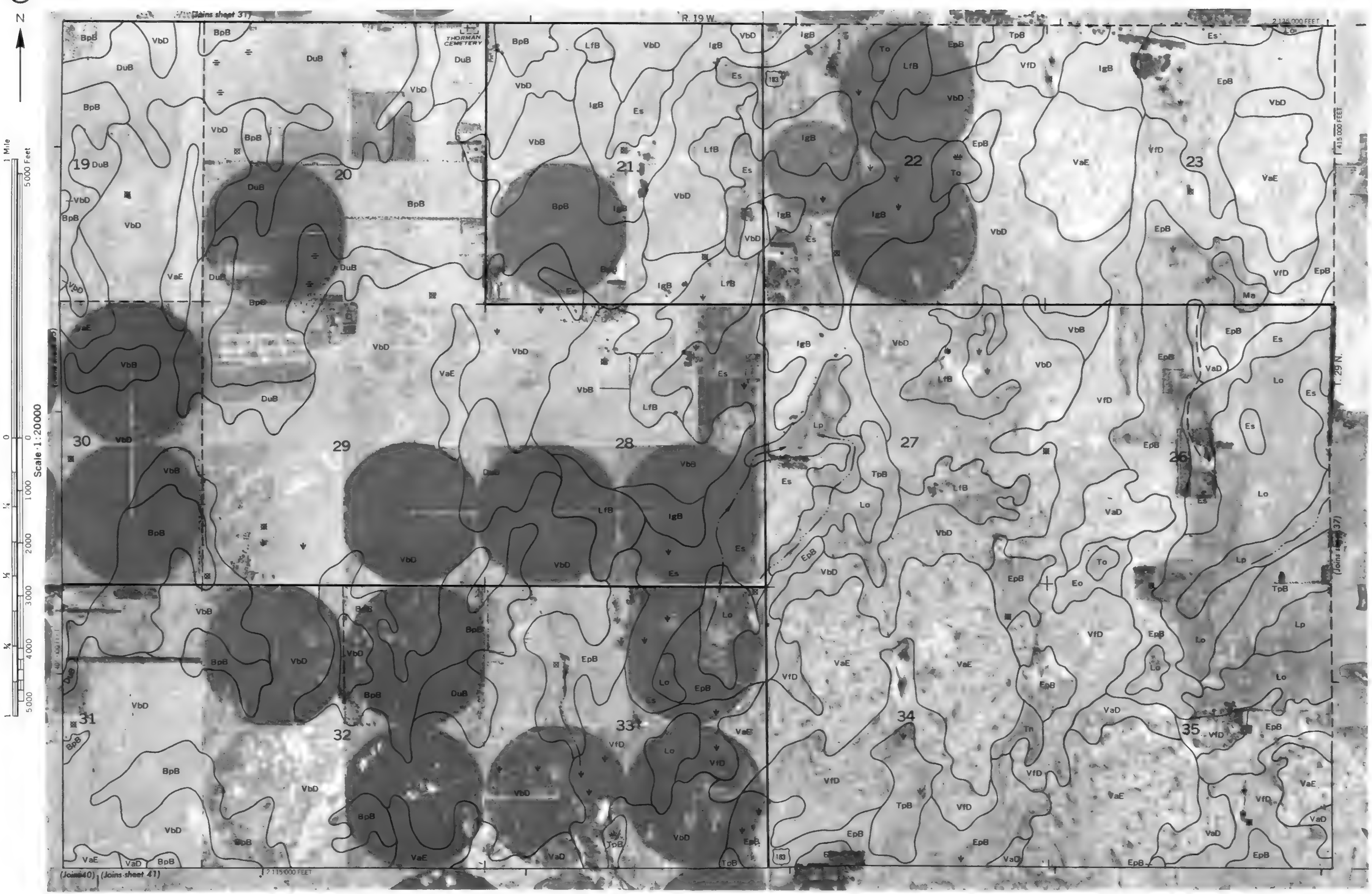
This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ROCK COUNTY, NEBRASKA NO. 34

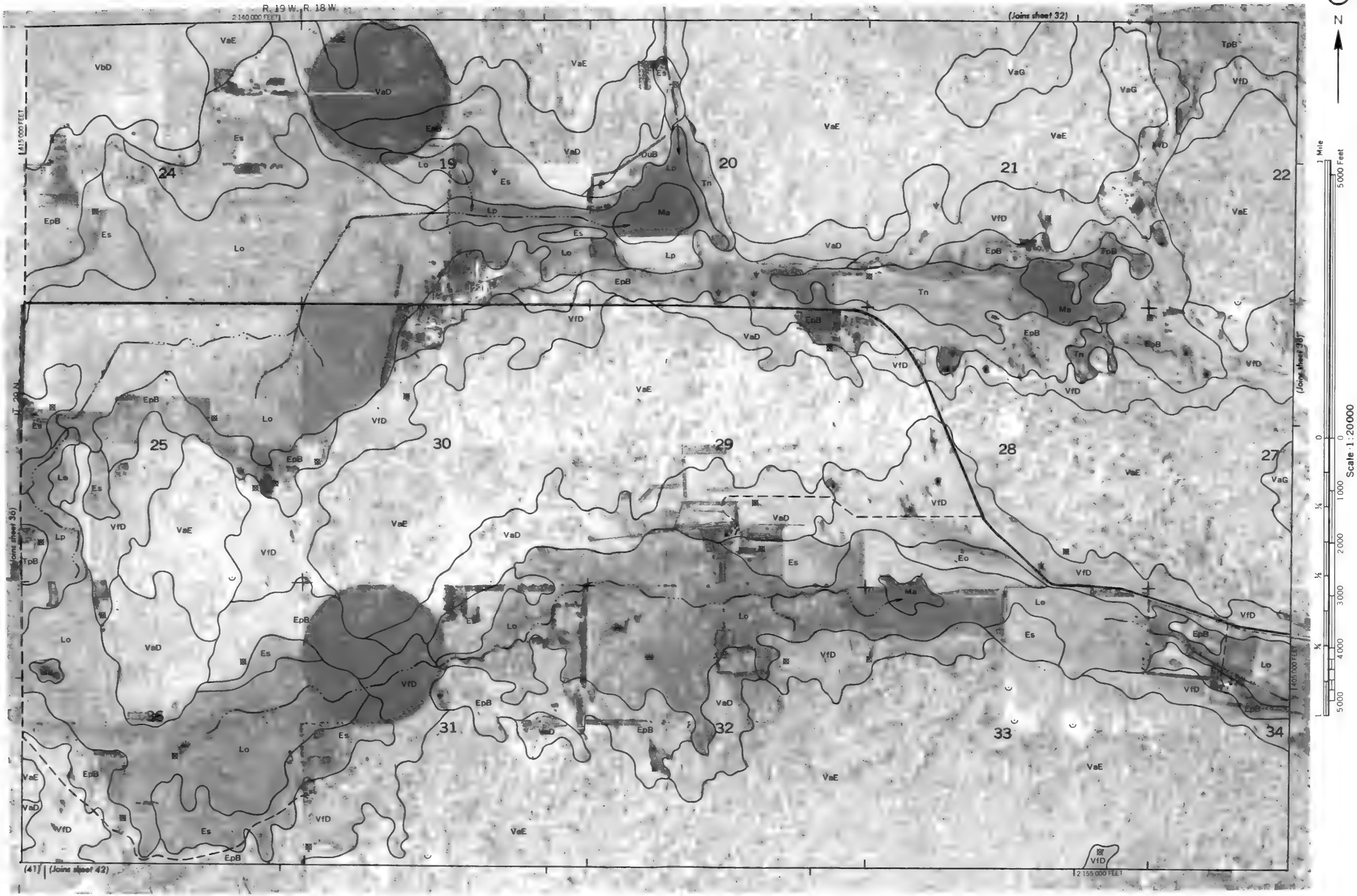


ROCK COUNTY, NEBRASKA NO. 35

This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



ROCK COUNTY, NEBRASKA NO. 36

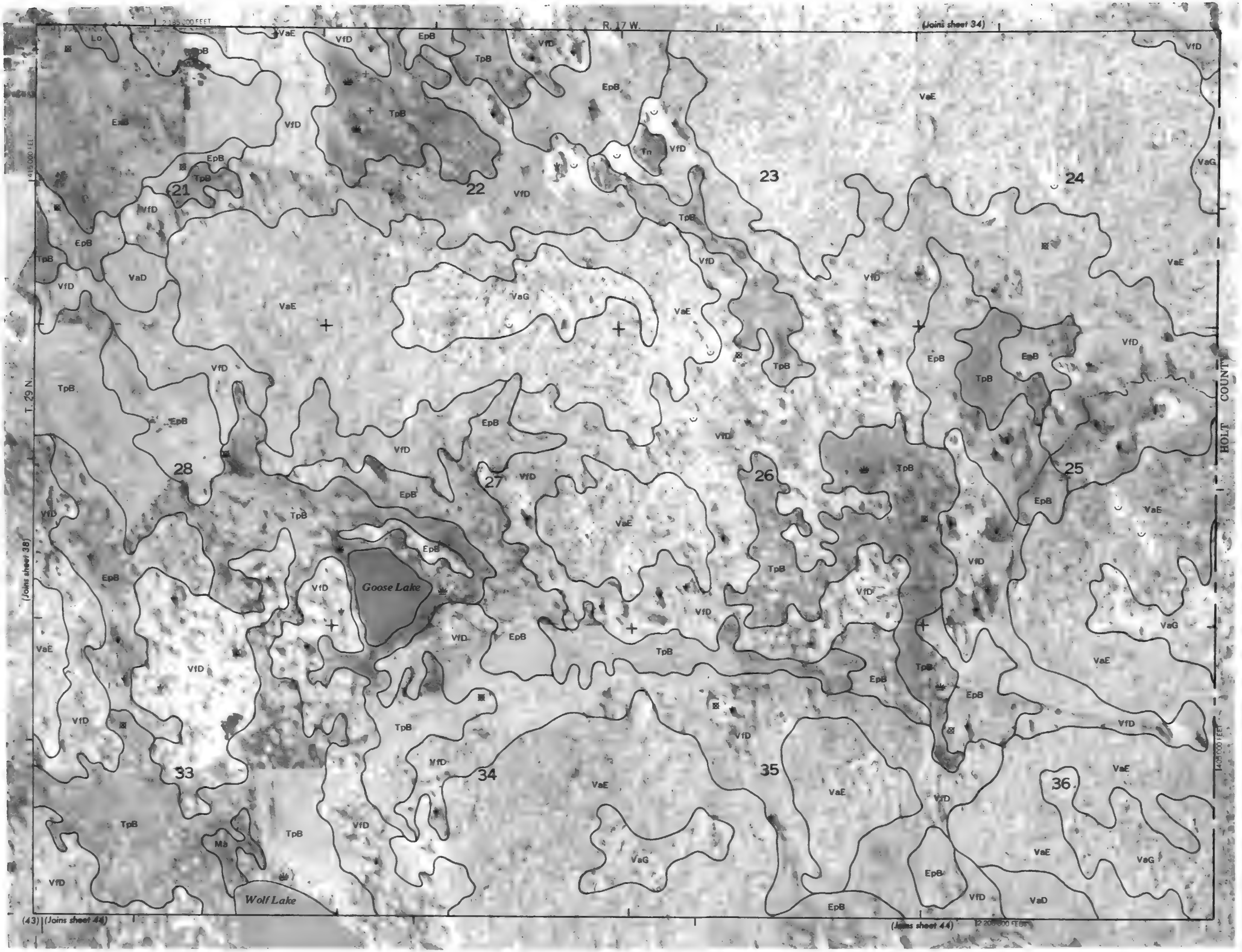


ROCK COUNTY, NEBRASKA NO. 37

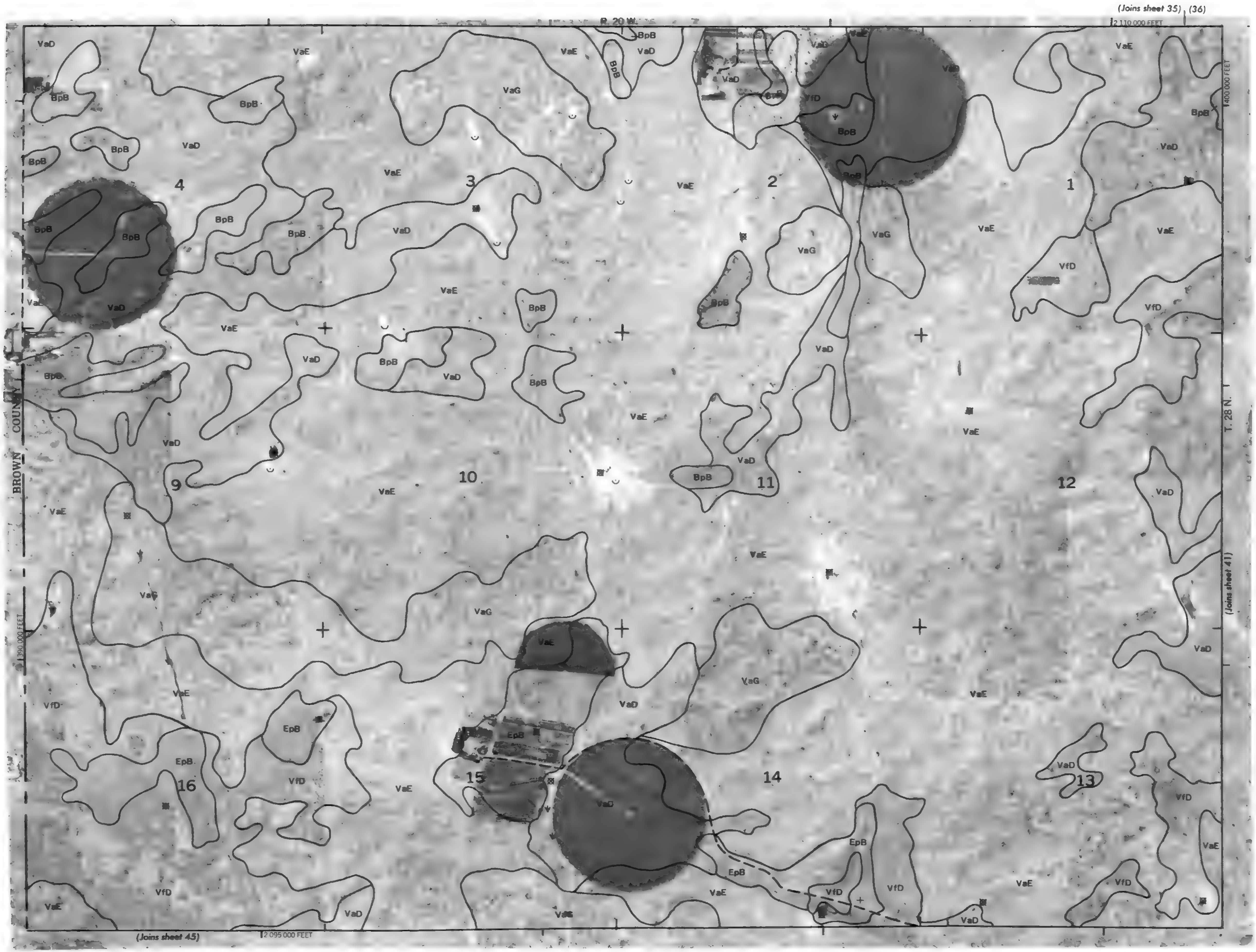
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ROCK COUNTY, NEBRASKA NO. 38

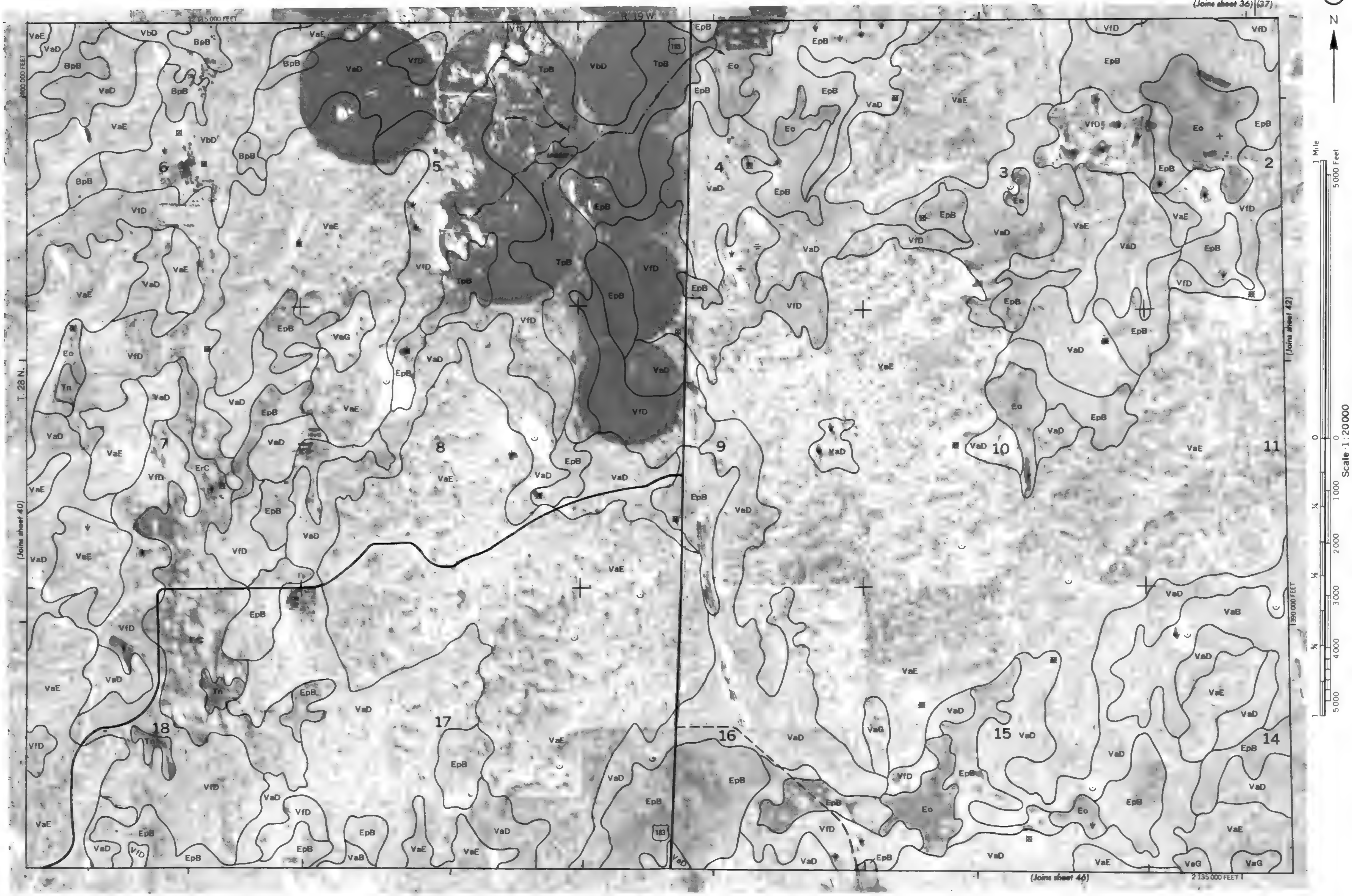


ROCK COUNTY, NEBRASKA NO. 39

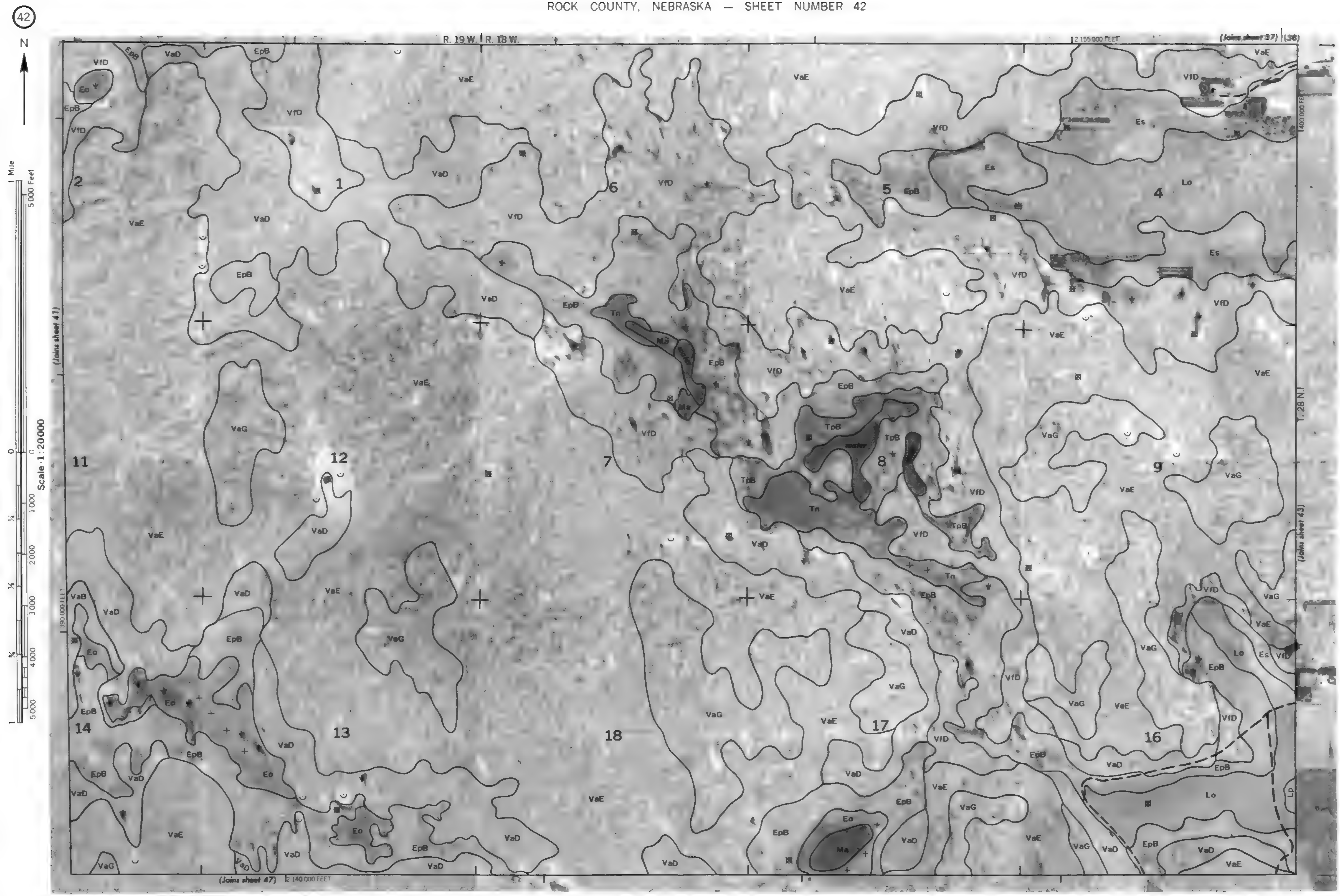


This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ROCK COUNTY, NEBRASKA NO. 40



ROCK COUNTY, NEBRASKA NO. 41

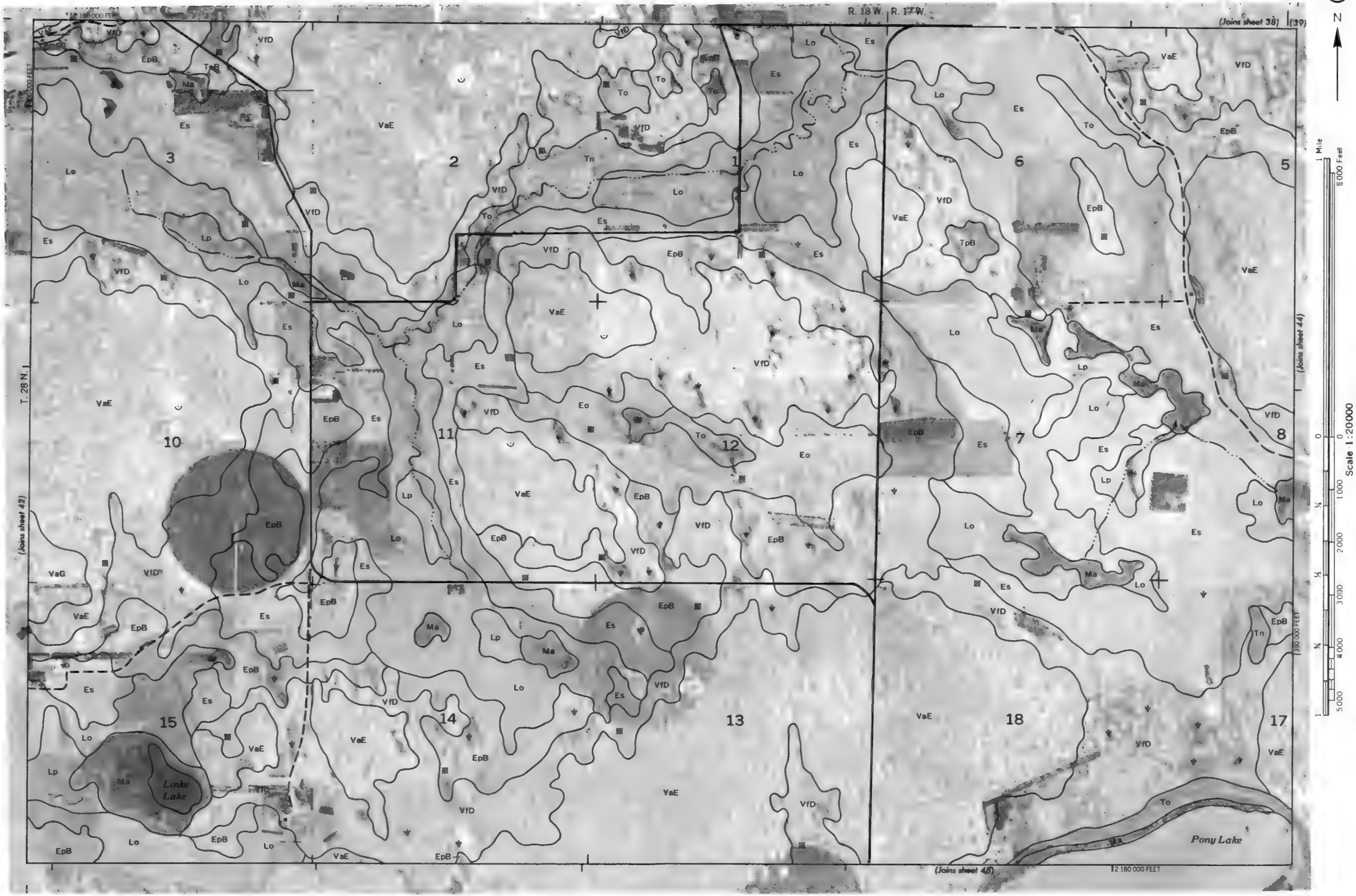


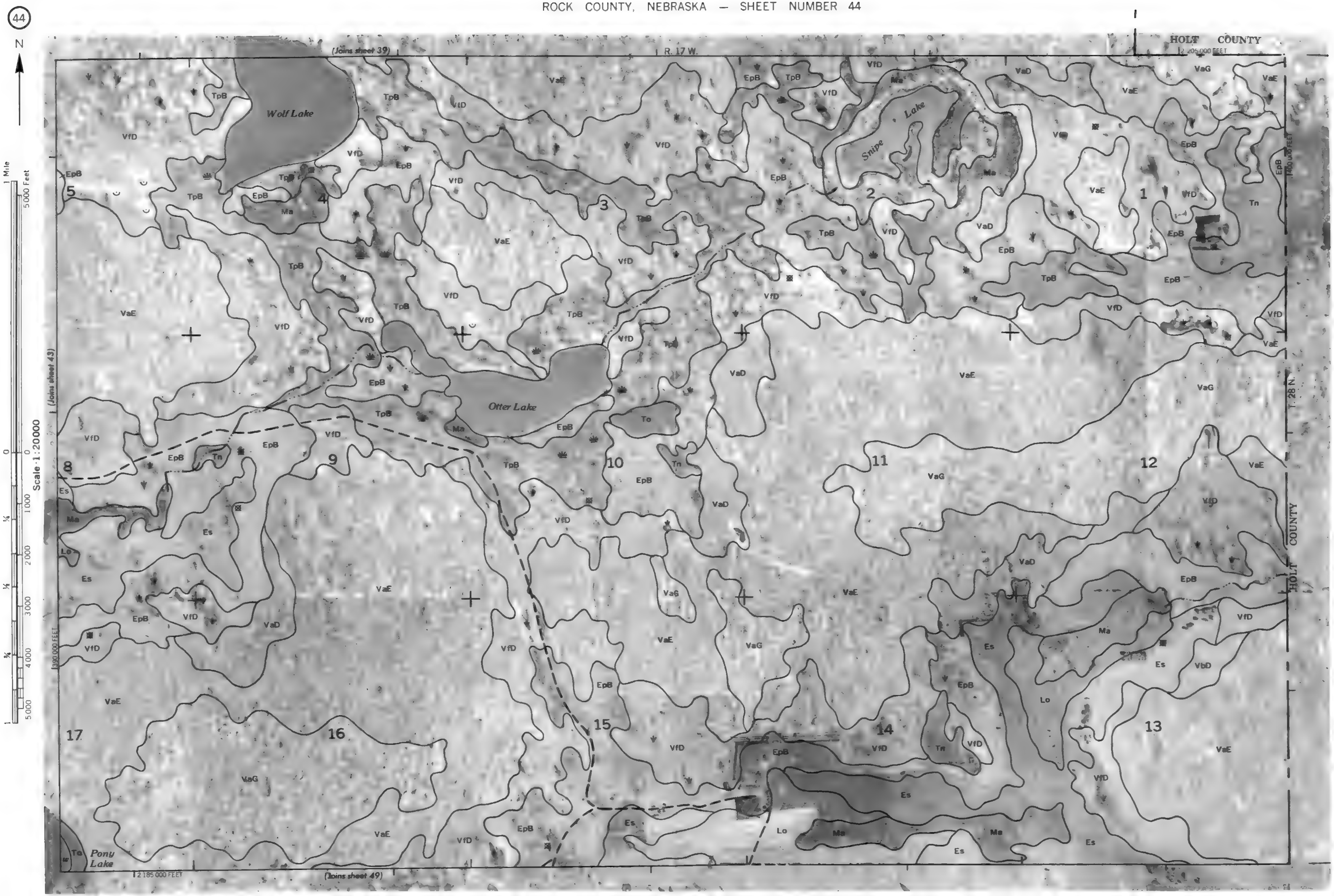
This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ROCK COUNTY, NEBRASKA NO. 42

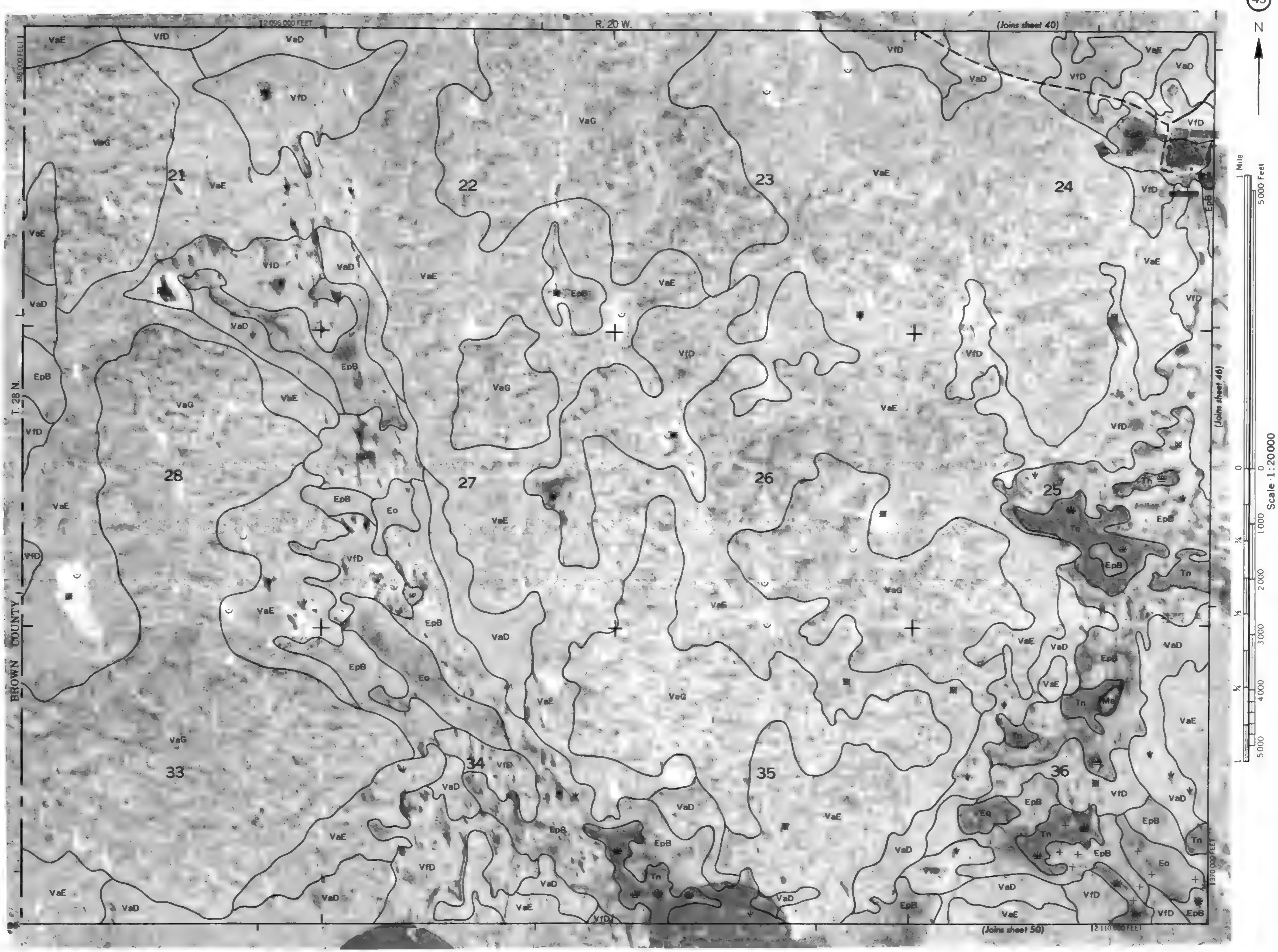
ROCK COUNTY, NEBRASKA NO. 43

This map is [illegible] on [illegible] aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



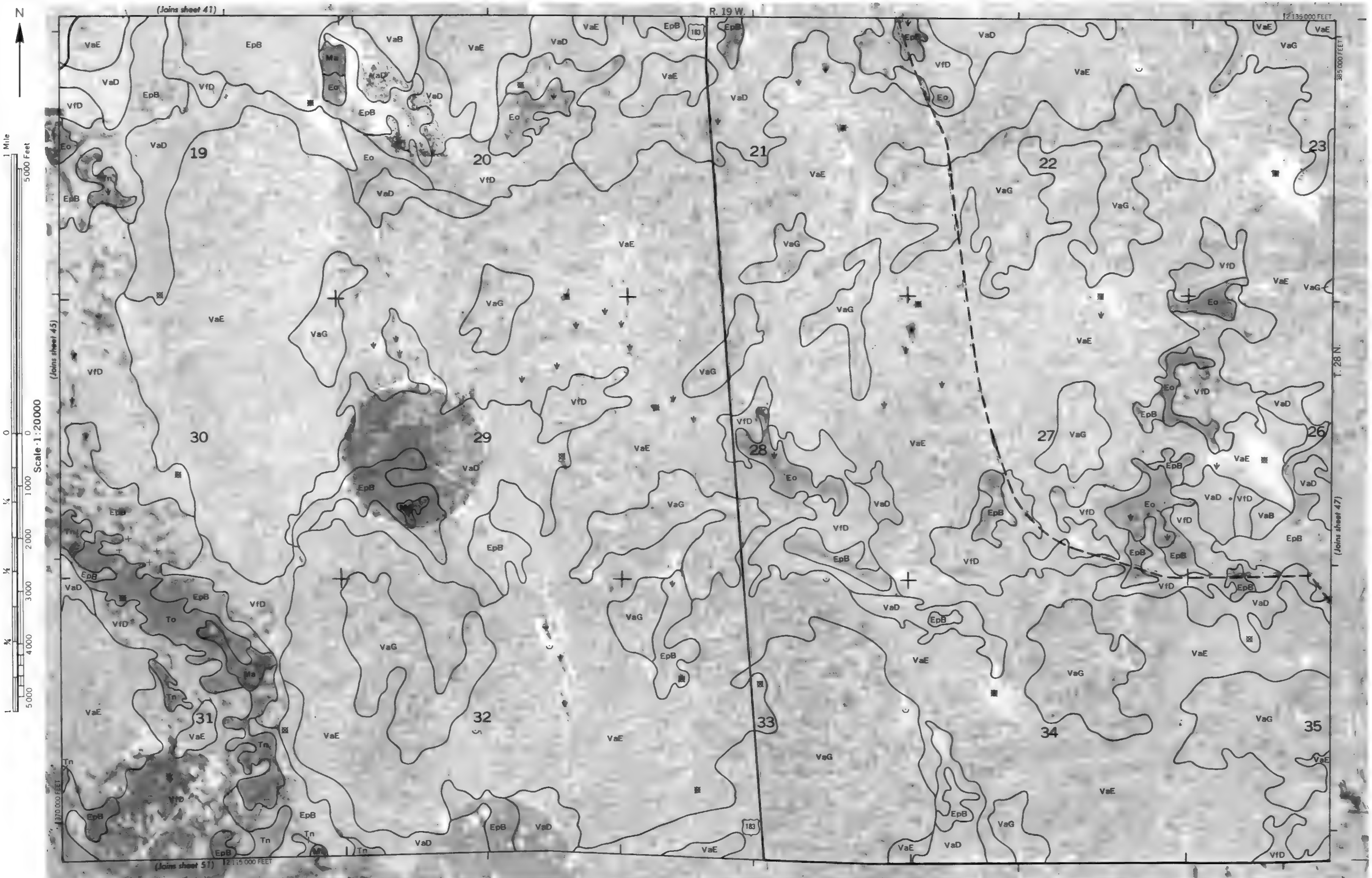


ROCK COUNTY, NEBRASKA NO. 44



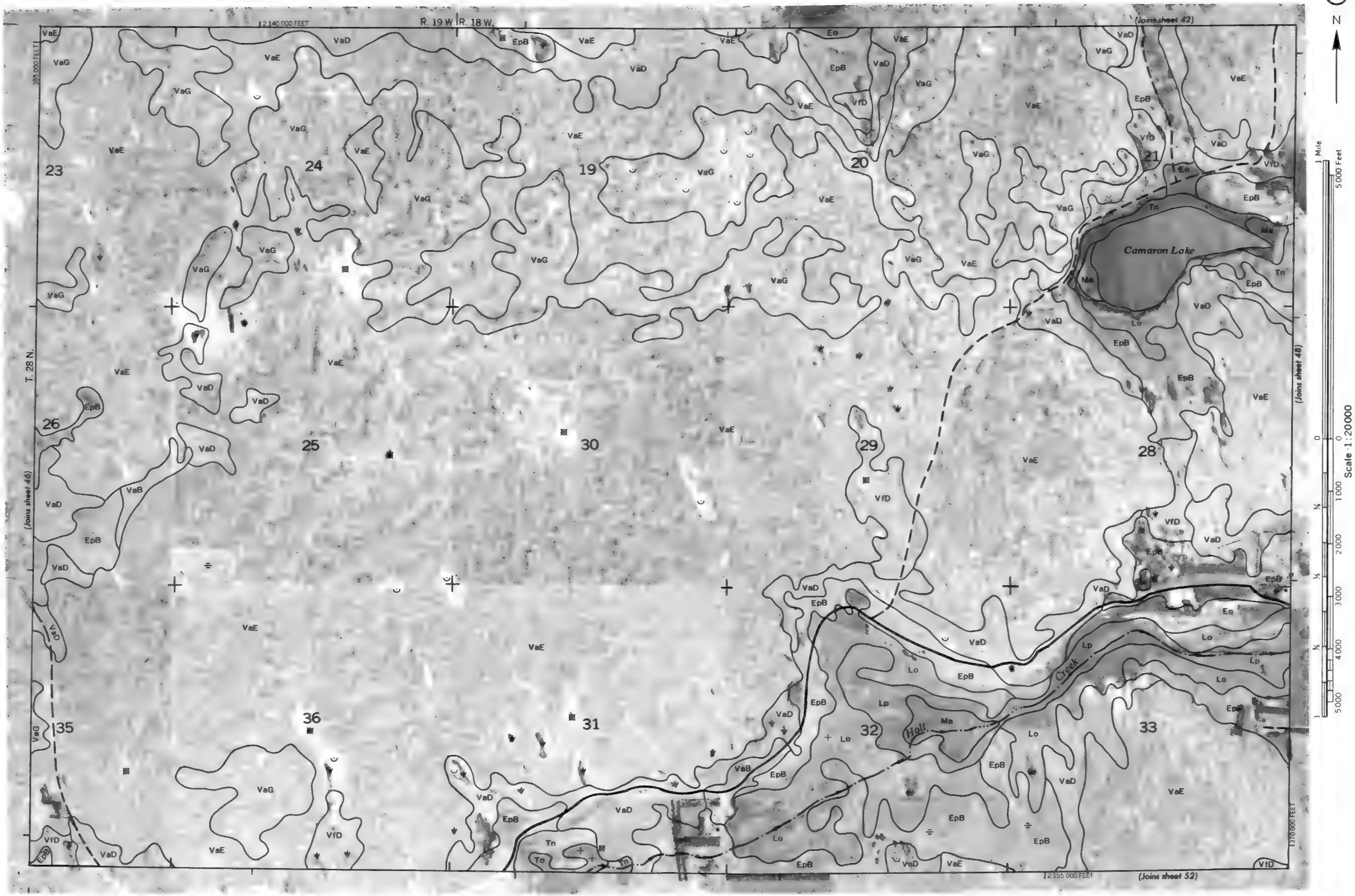
ROCK COUNTY, NEBRASKA NO. 45

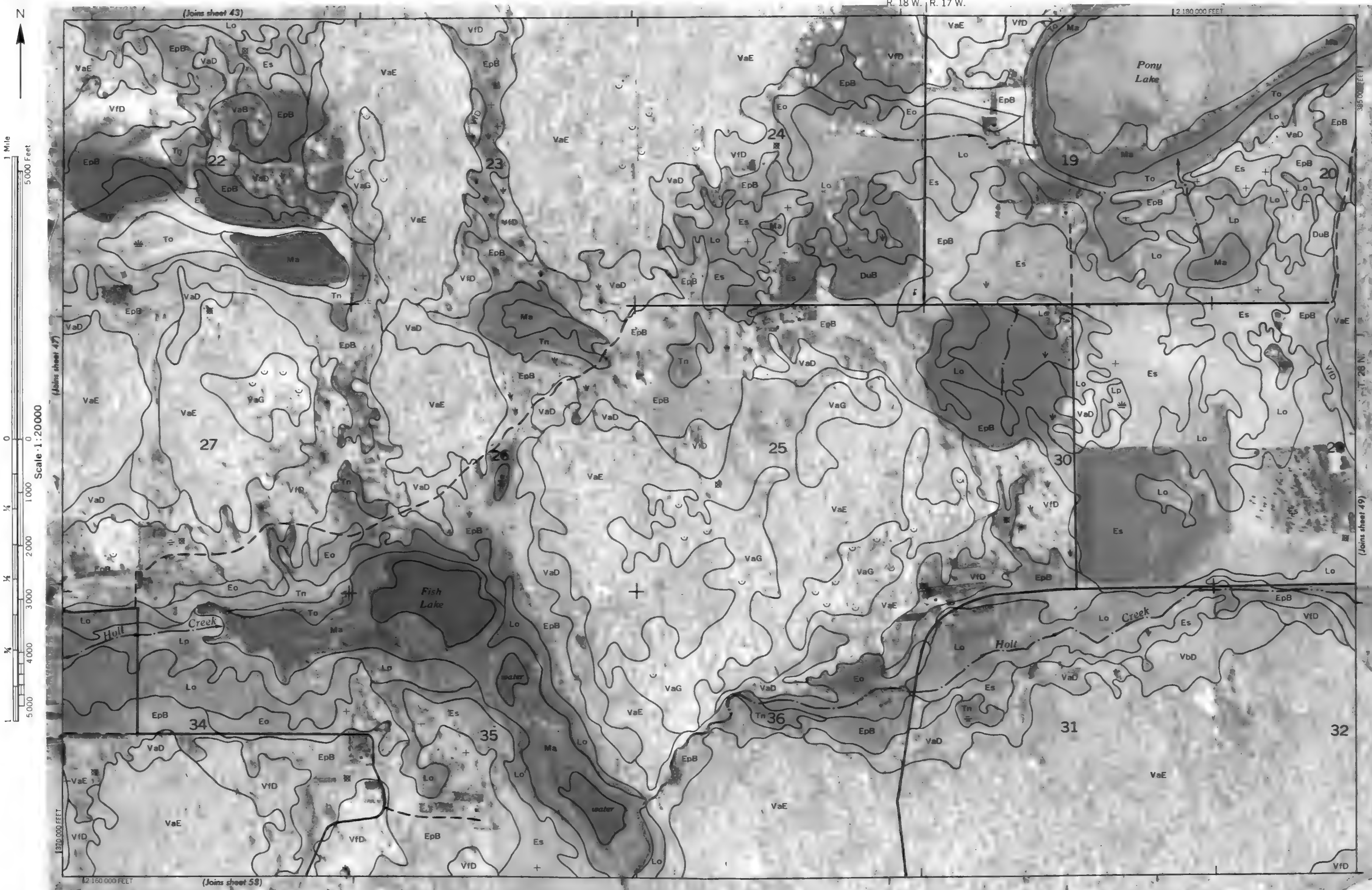
This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



ROCK COUNTY, NEBRASKA NO. 46

ROCK COUNTY, NEBRASKA NO. 47




N
1 Mile
5000 Feet
Scale 1:20000
(Joins sheet 43)
(Joins sheet 47)
(Joins sheet 49)
(Joins sheet 58)
R. 18 W.
R. 17 W.
T. 28 N.
2 180 000 FEET
2 160 000 FEET
320 000 FEET
Pony Lake
Fish Lake
Holt Creek
water

ROCK COUNTY, NEBRASKA NO. 49

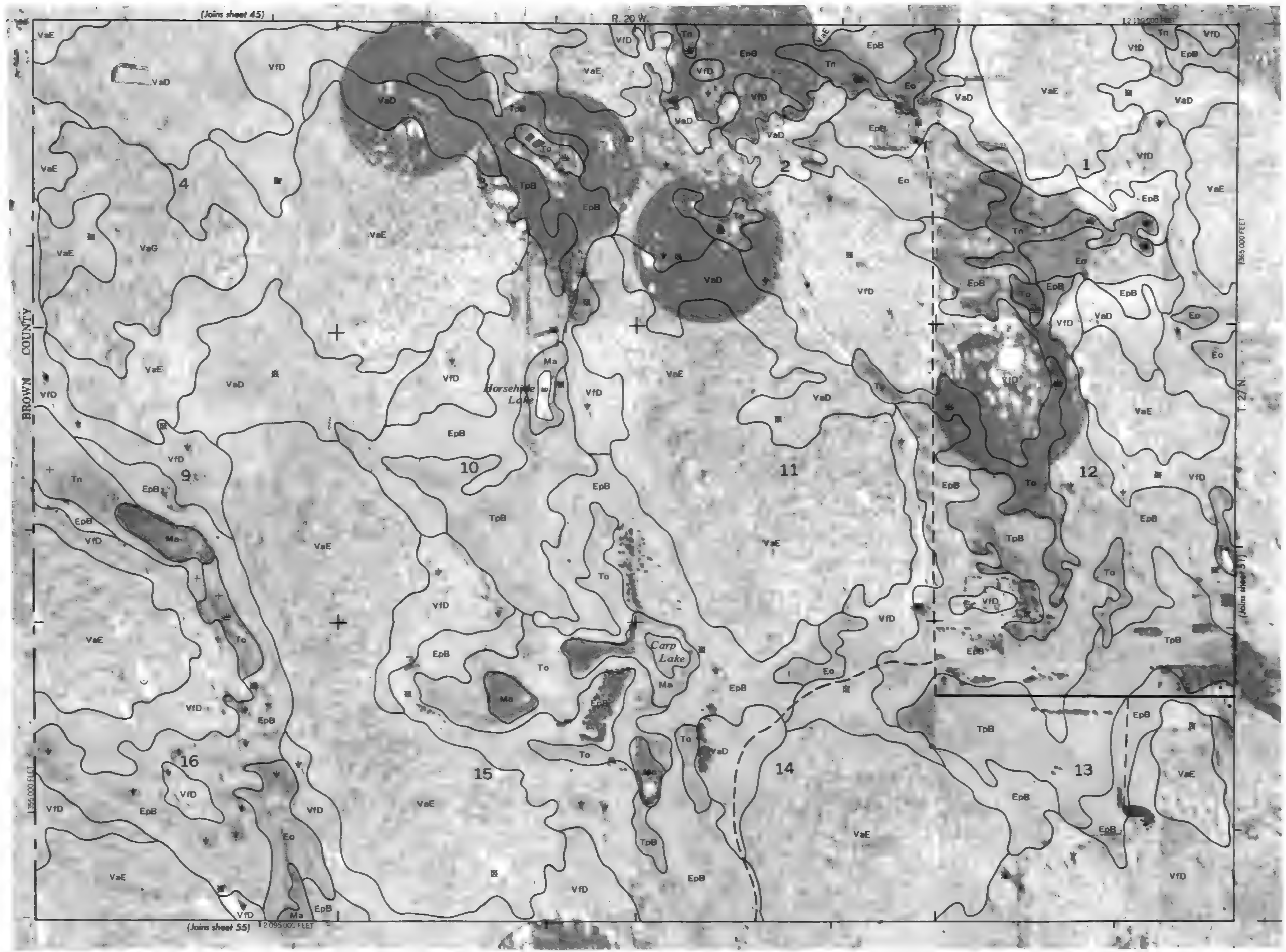
50

N

Scale 1:20000

1 Mile

5000 Feet

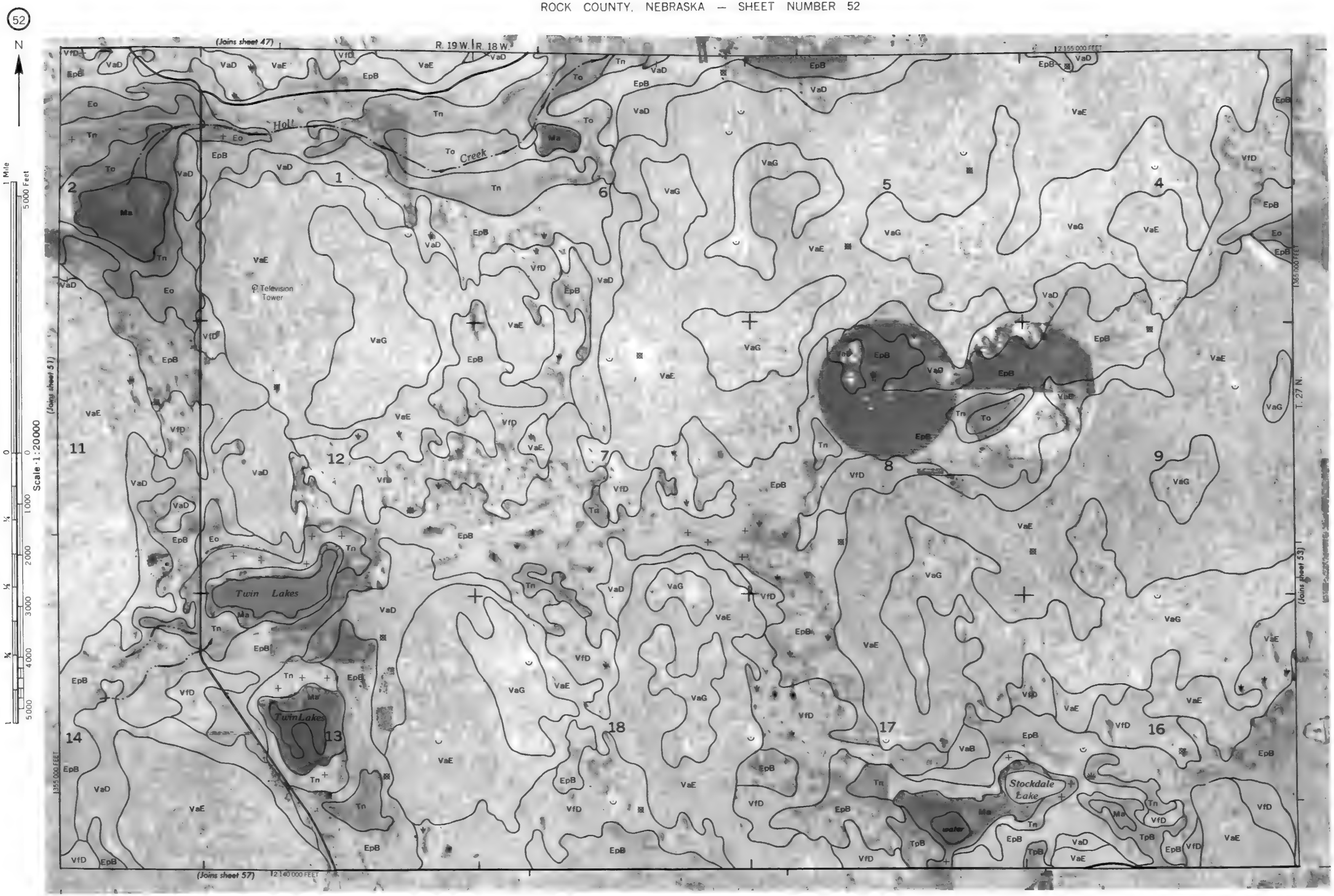


ROCK COUNTY, NEBRASKA NO. 50

This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ROCK COUNTY, NEBRASKA NO. 51

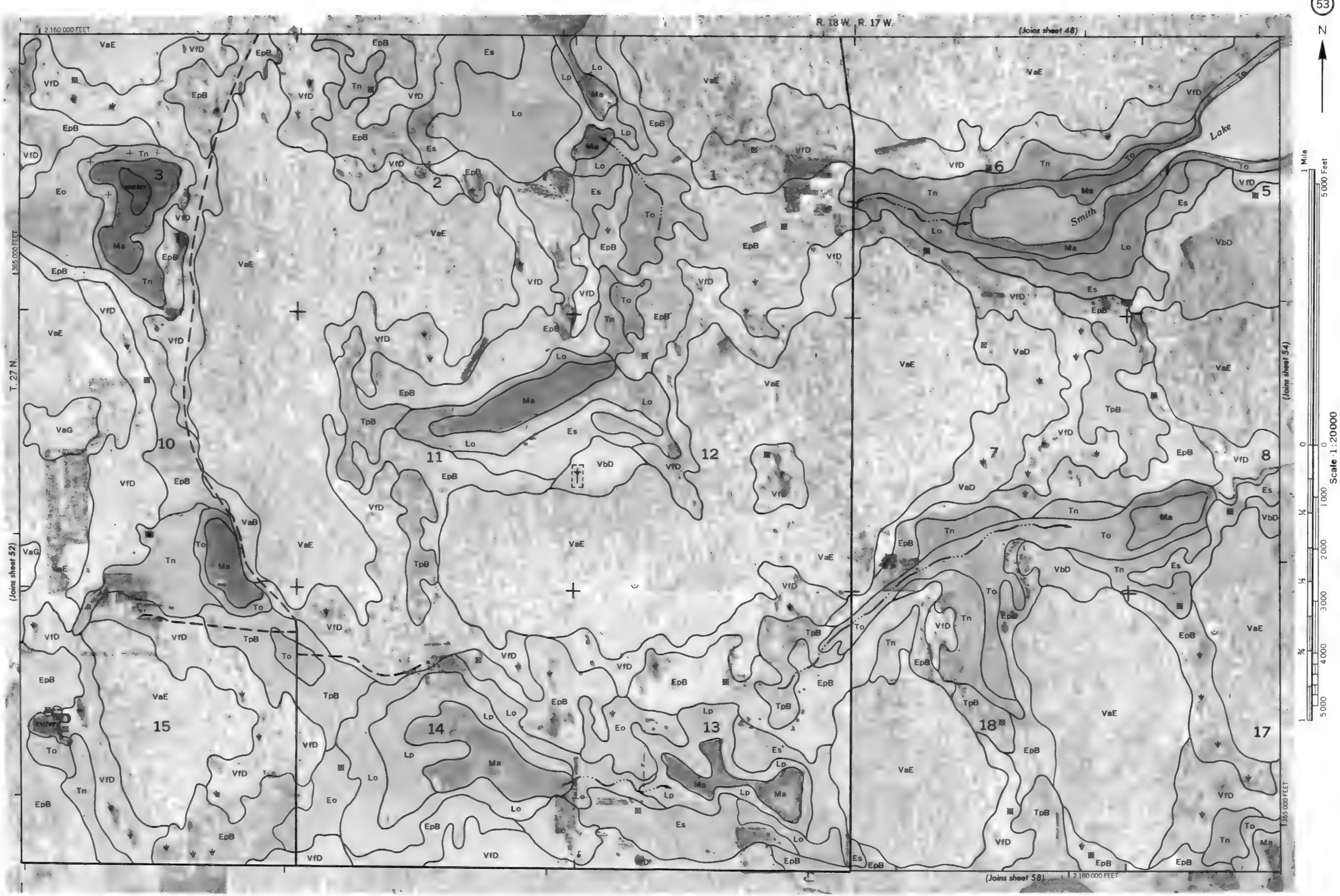
This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

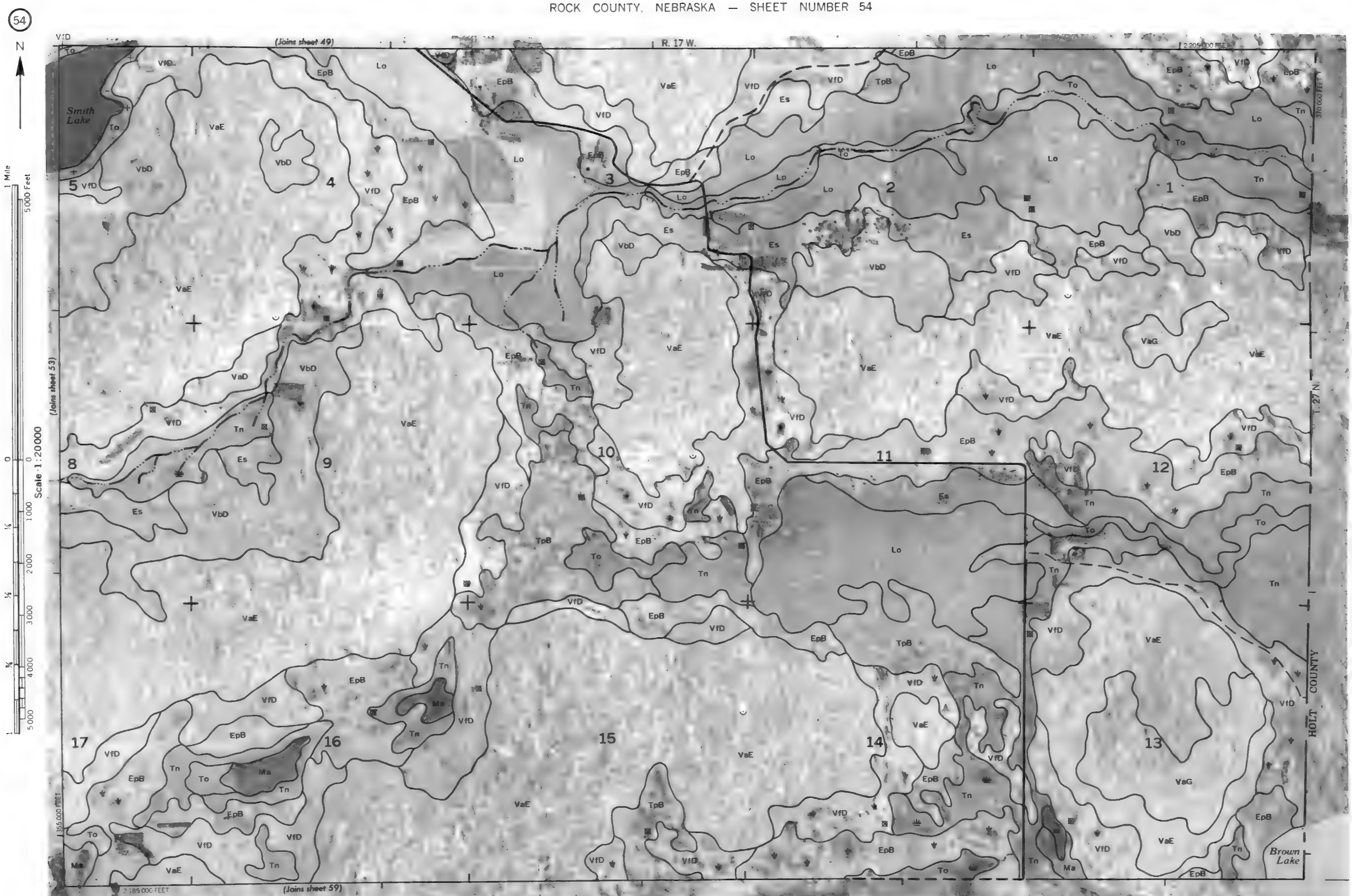


ROCK COUNTY, NEBRASKA NO. 52

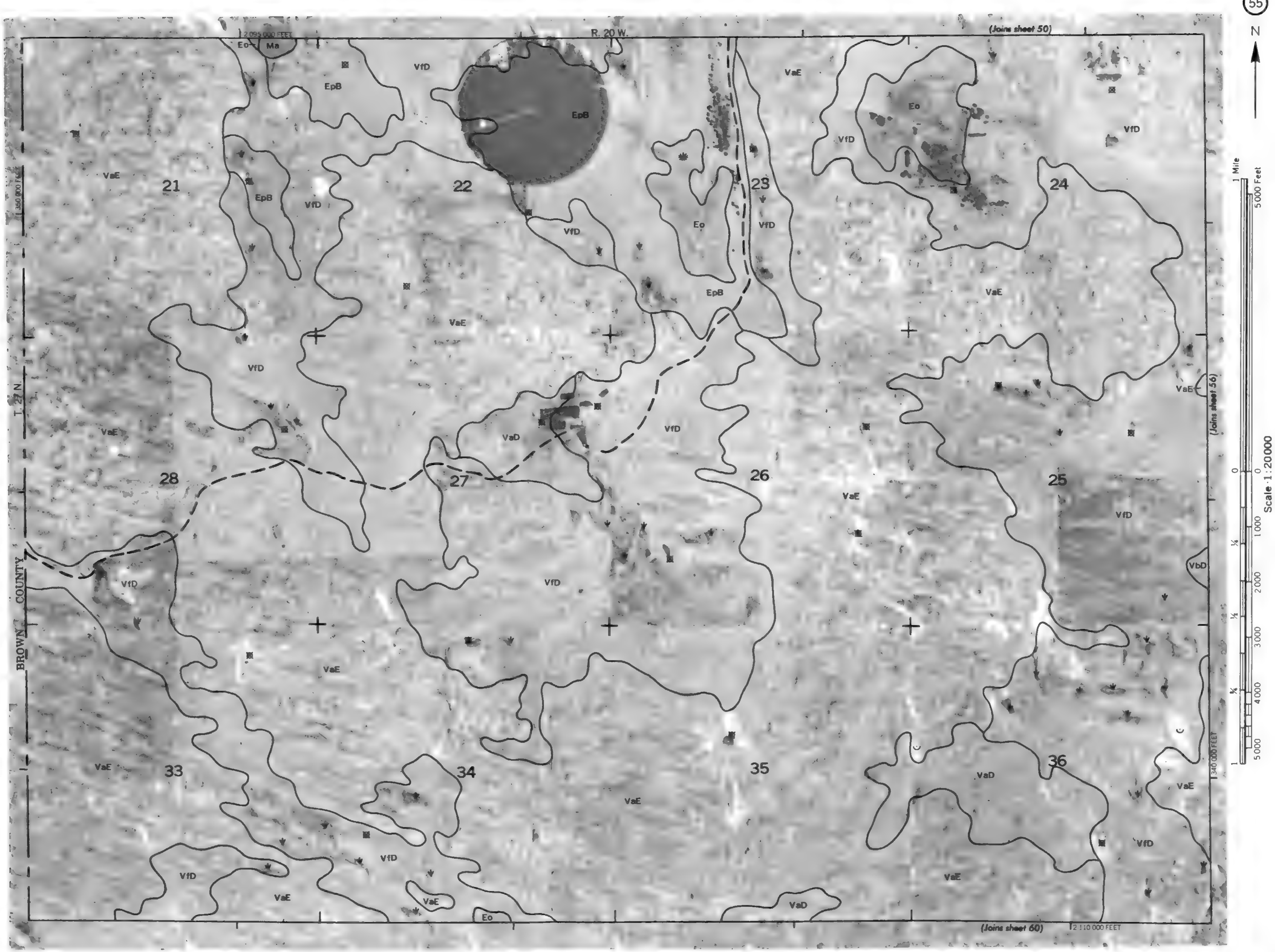
ROCK COUNTY, NEBRASKA NO. 53

This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

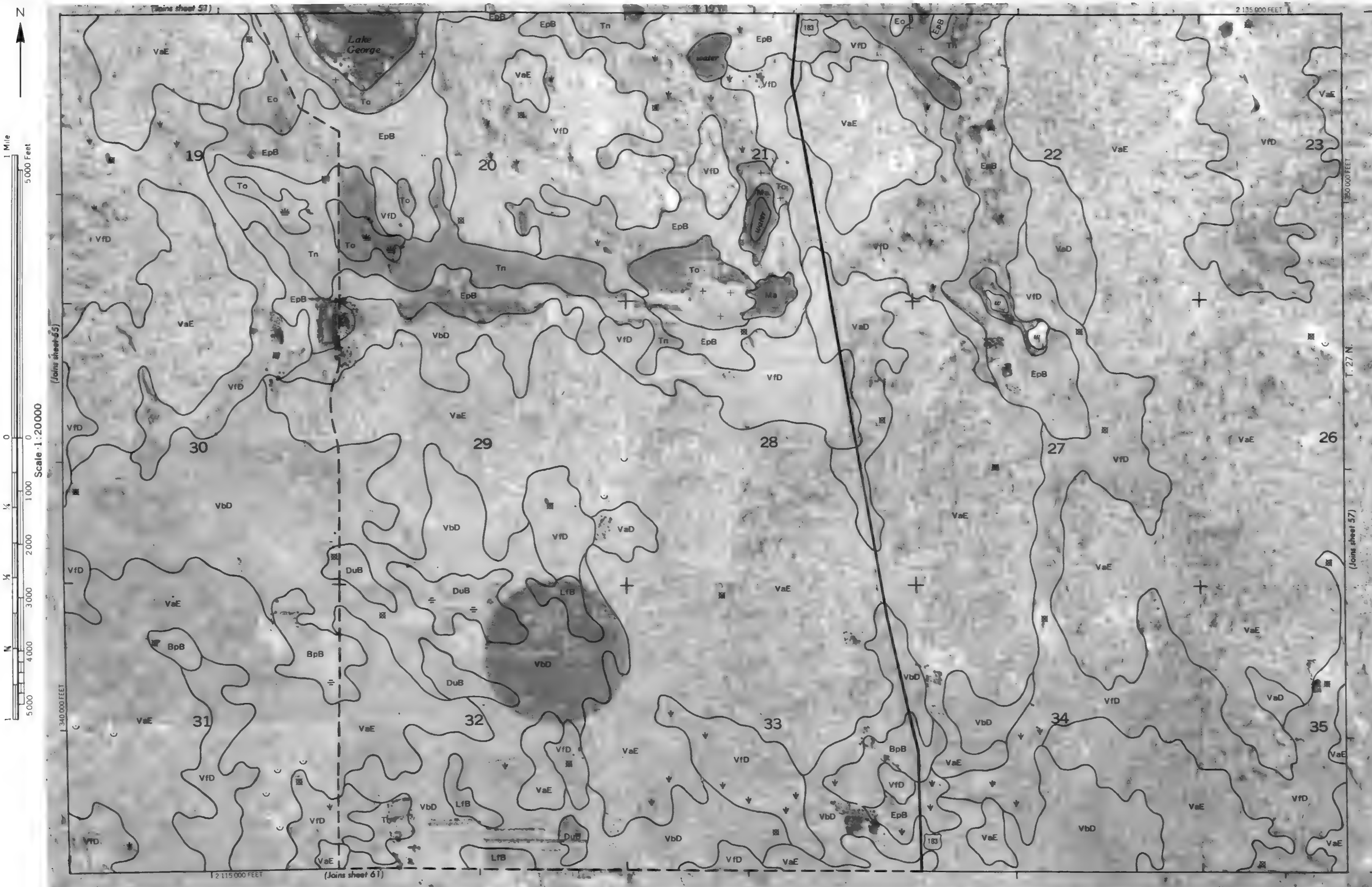




ROCK COUNTY, NEBRASKA NO. 54



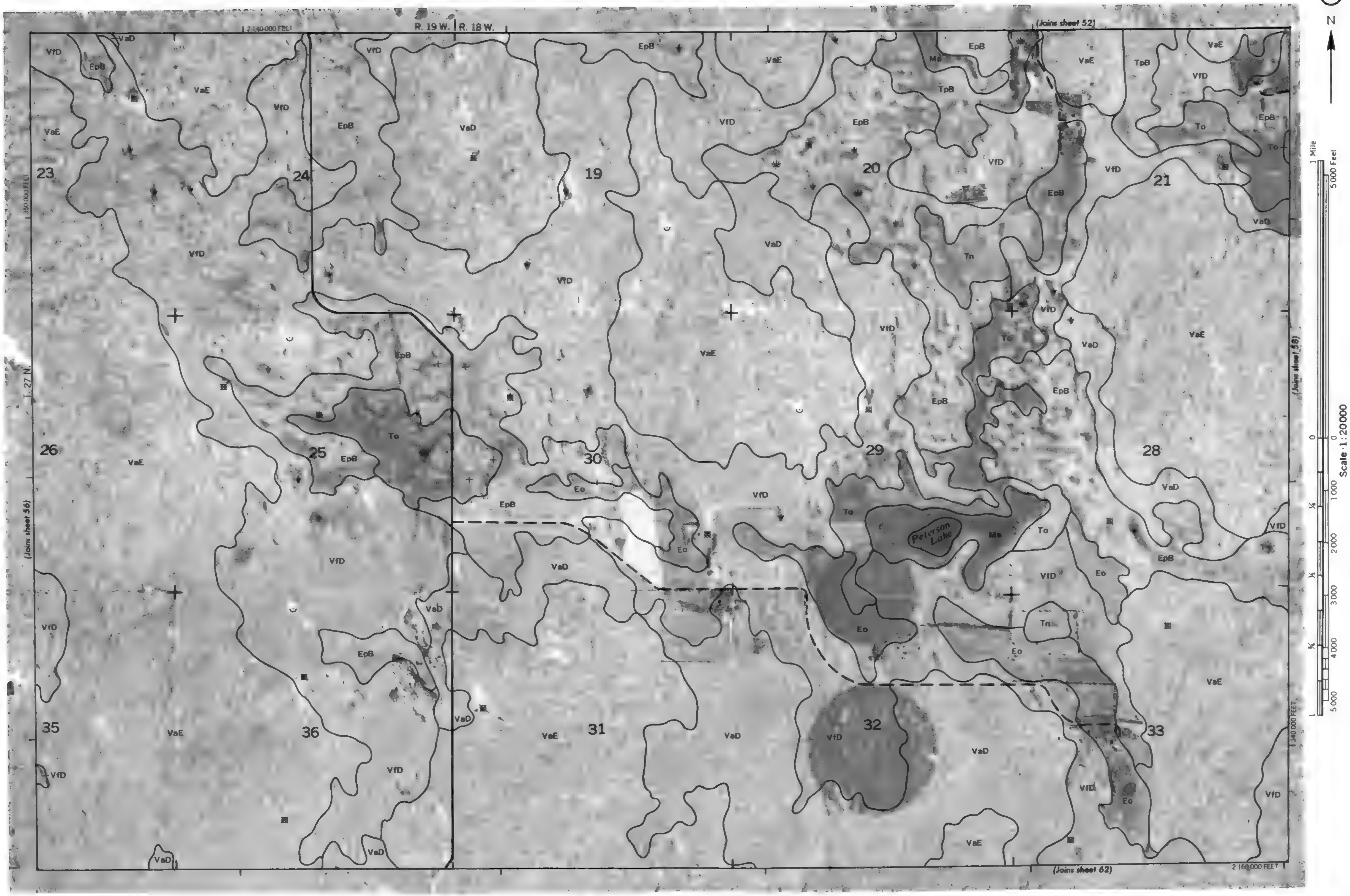
ROCK COUNTY, NEBRASKA NO. 55

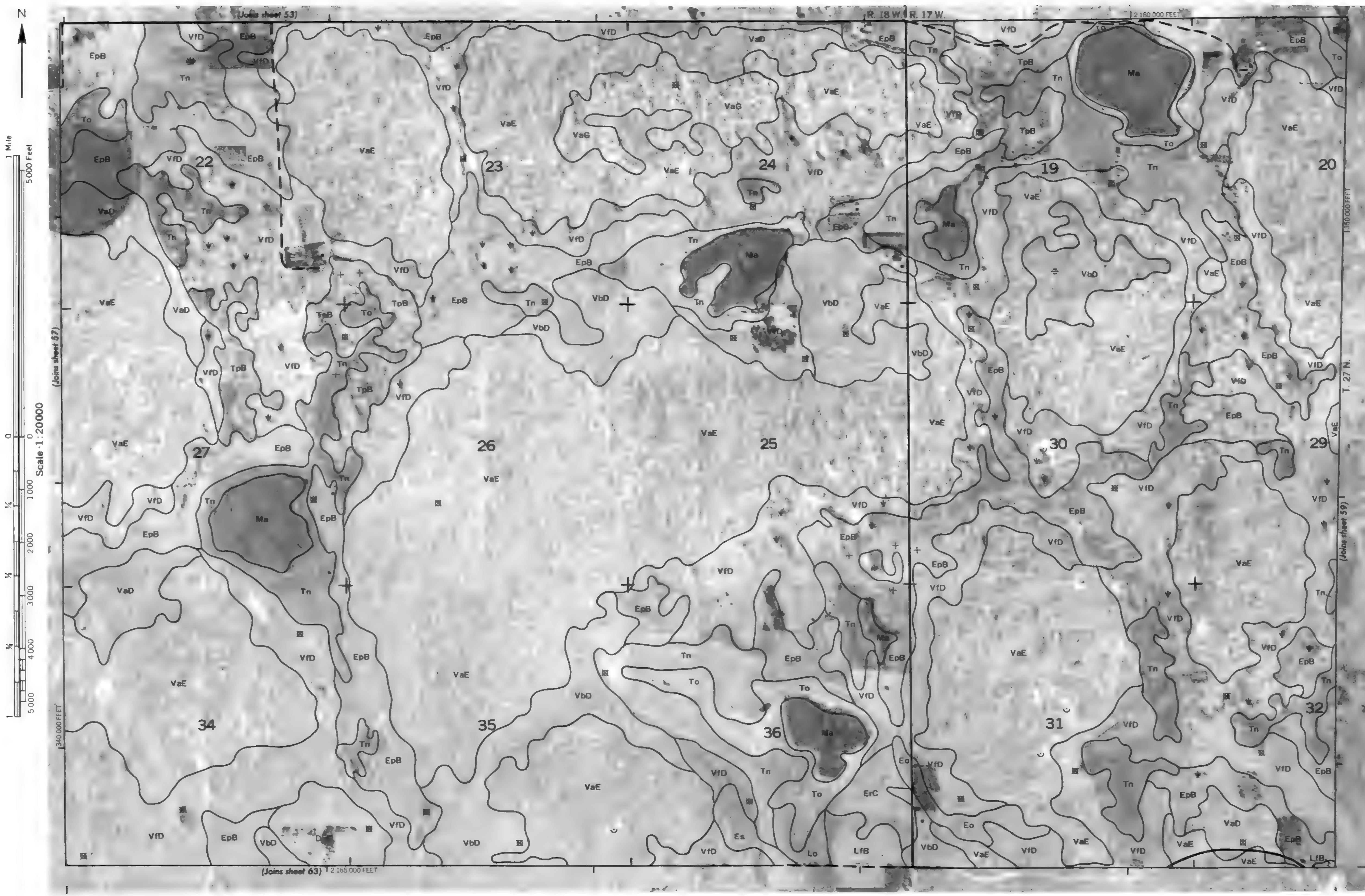


This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

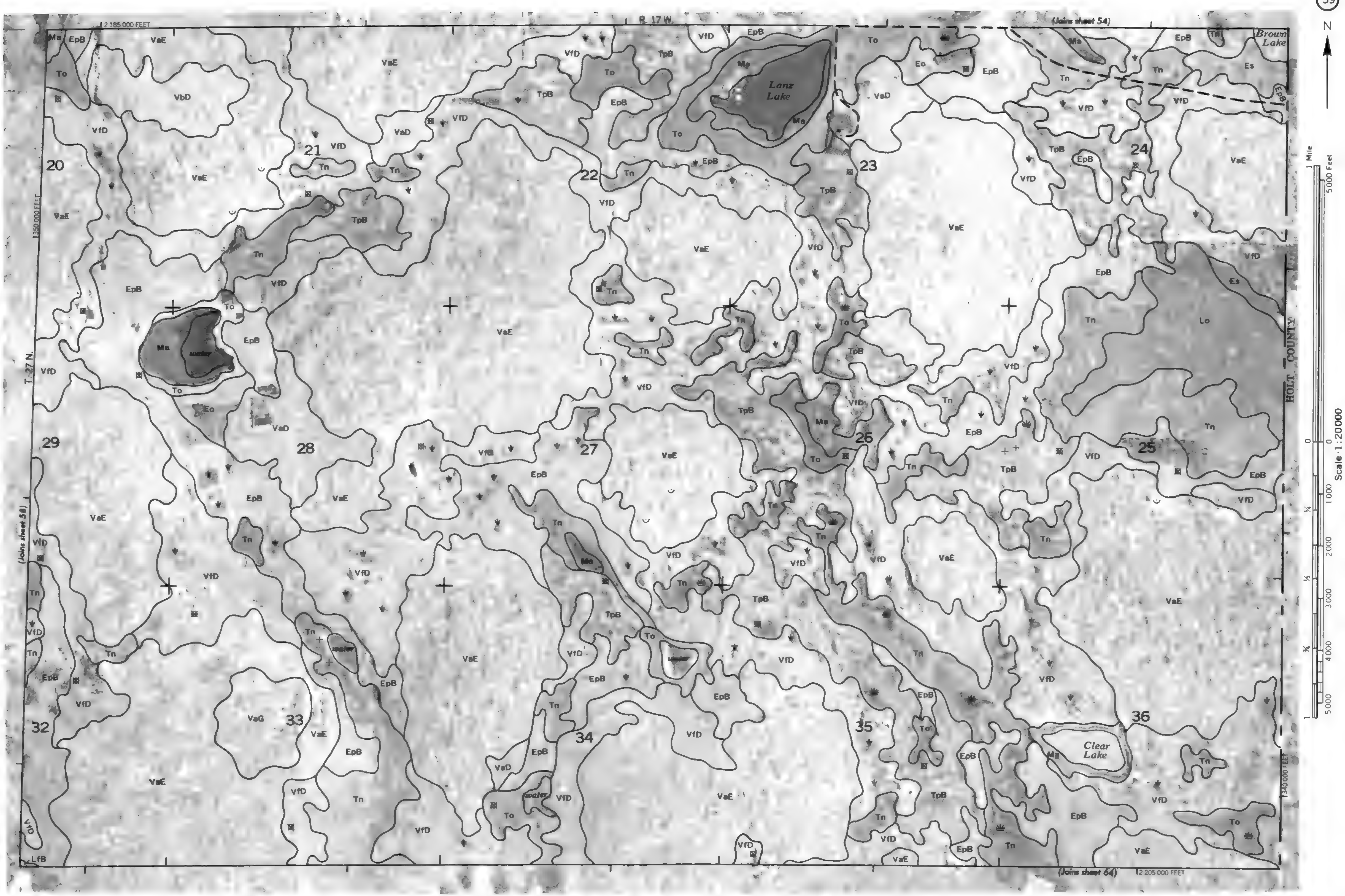
ROCK COUNTY, NEBRASKA NO. 56

ROCK COUNTY, NEBRASKA NO. 57




N
1 Mile
5000 Feet
Scale 1:20000
(Joins sheet 53)
(Joins sheet 57)
(Joins sheet 59)
(Joins sheet 63)
R. 18 W.
R. 17 W.
T. 27 N.
2 180 000 FEET
2 165 000 FEET
350 000 FEET
340 000 FEET
22
23
24
19
20
27
26
25
30
29
34
35
36
31
32
EpB
VfD
Tn
To
VaD
VaE
VaG
Ma
TpB
VbD
ErC
Eo
Es
Lo
LfB

59



ROCK COUNTY, NEBRASKA NO. 59

This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

60

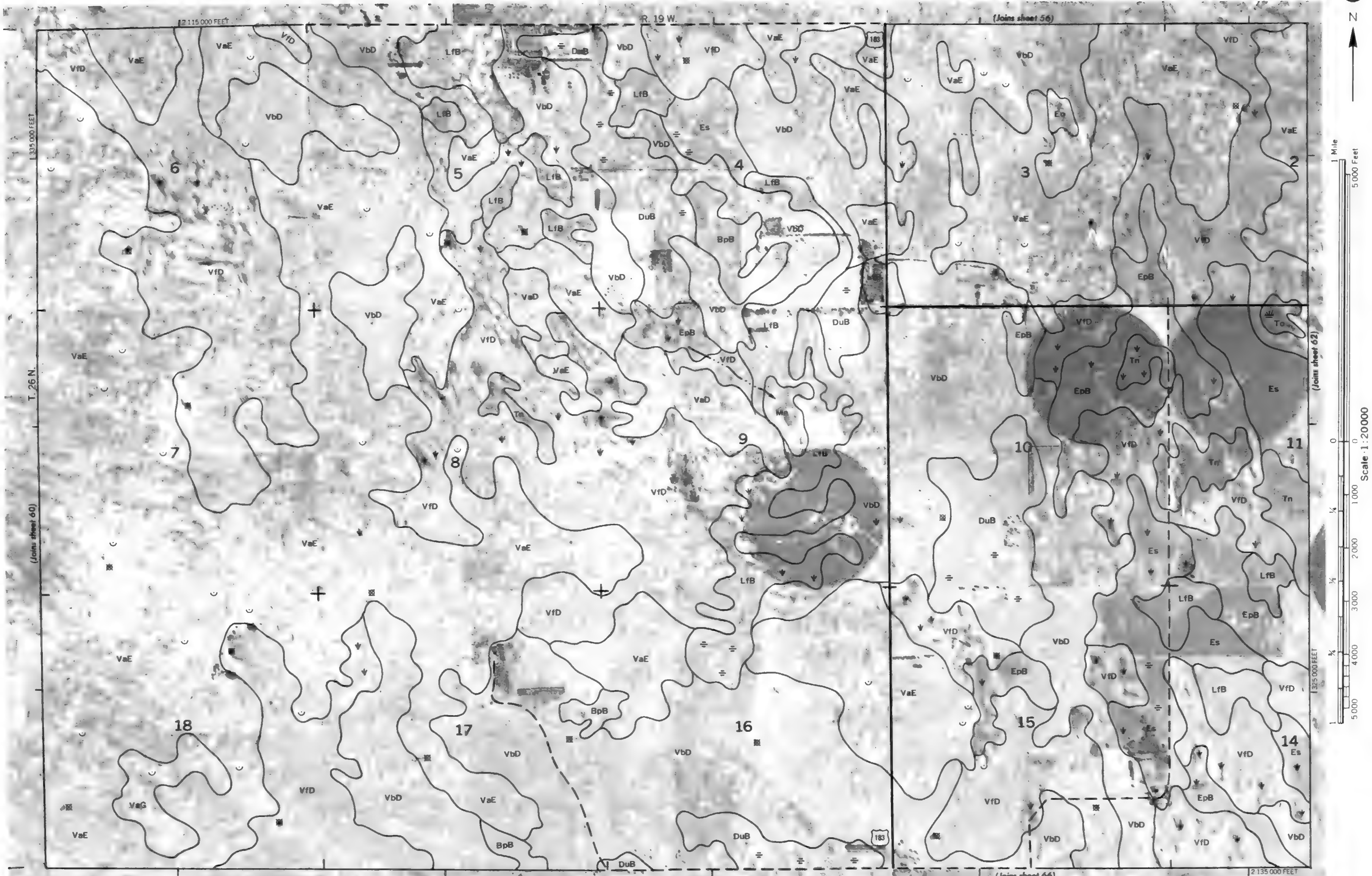
N

Scale 1:20000

1 Mile

5000 Feet

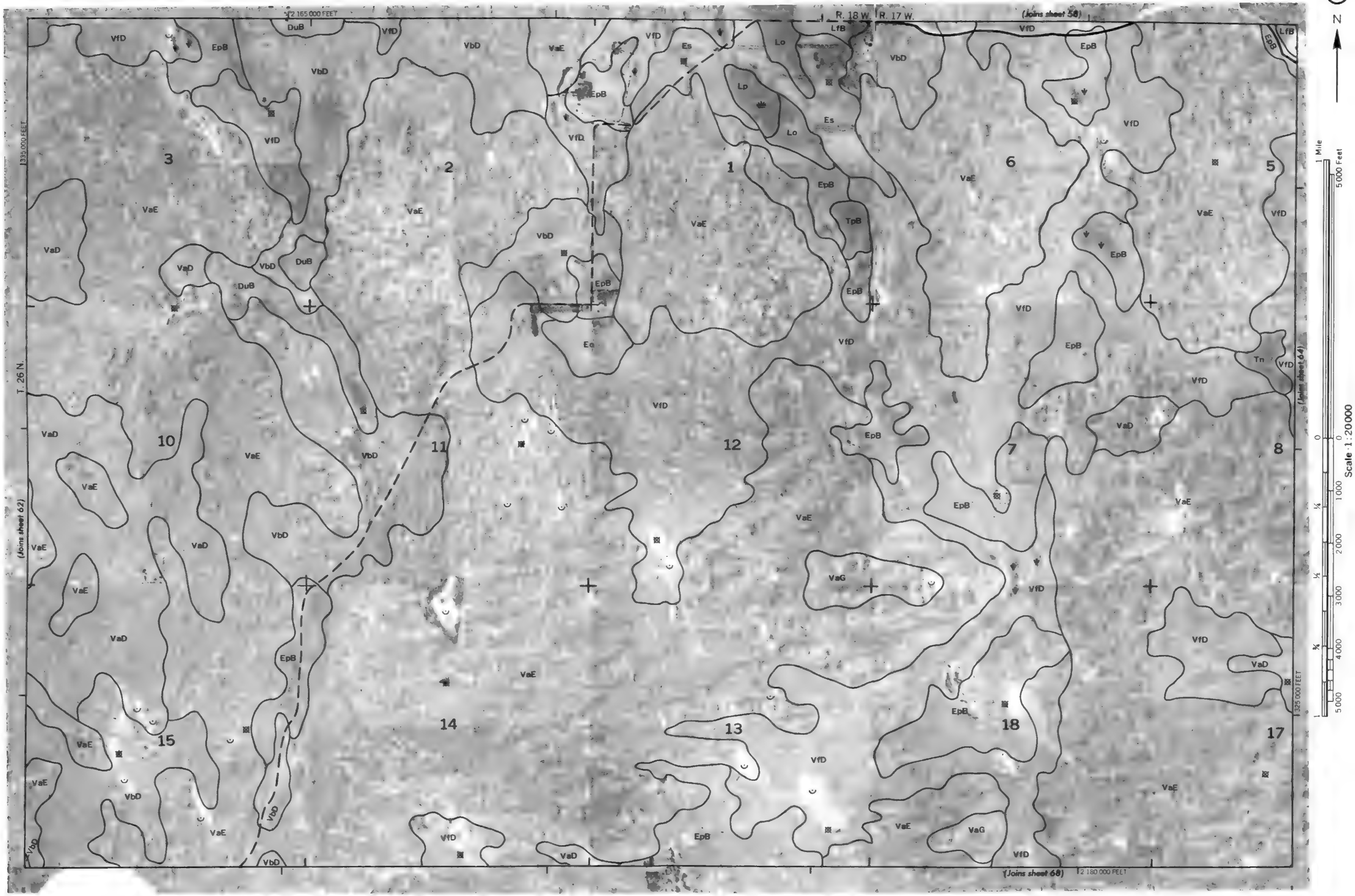
This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

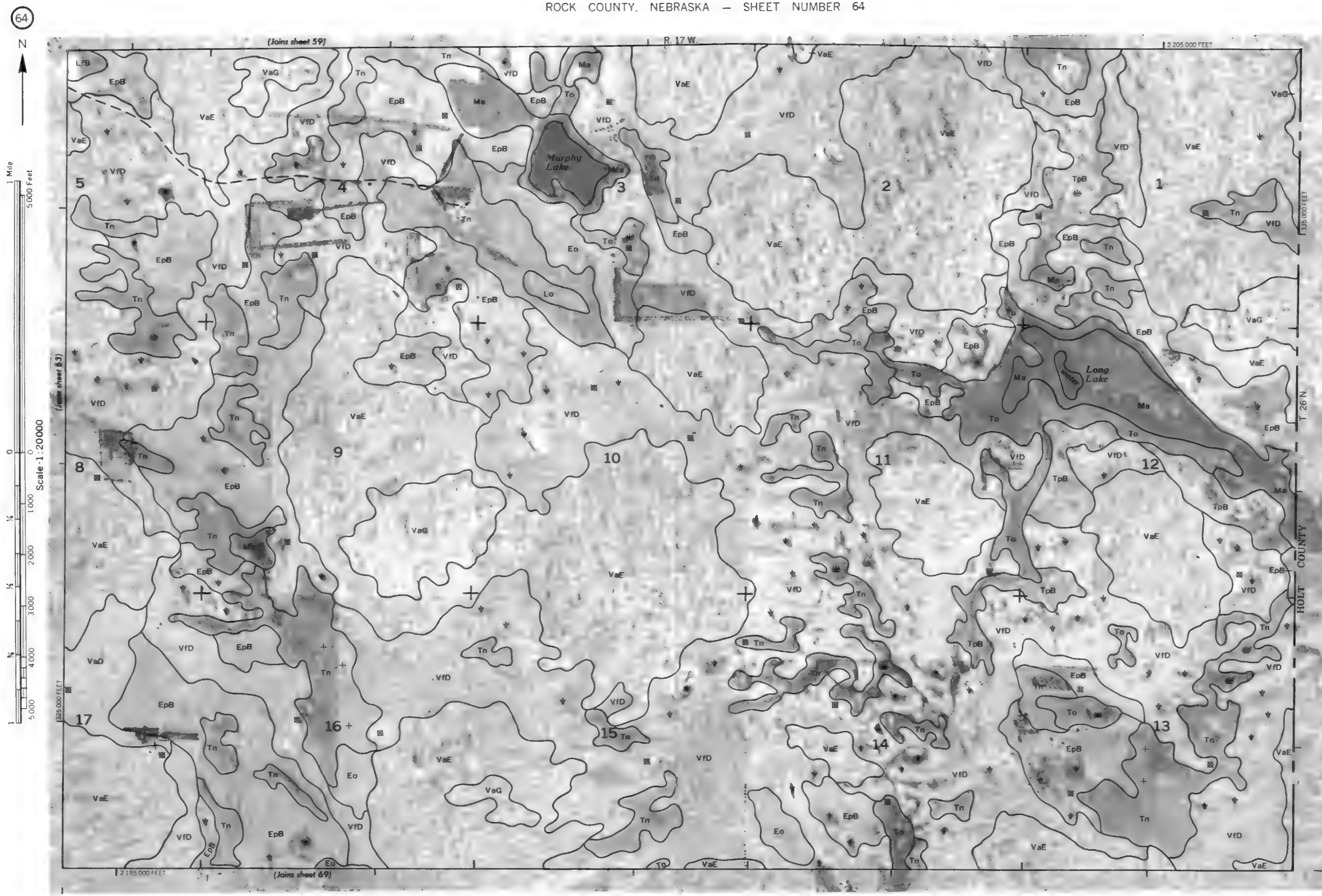


ROCK COUNTY, NEBRASKA NO. 61

This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

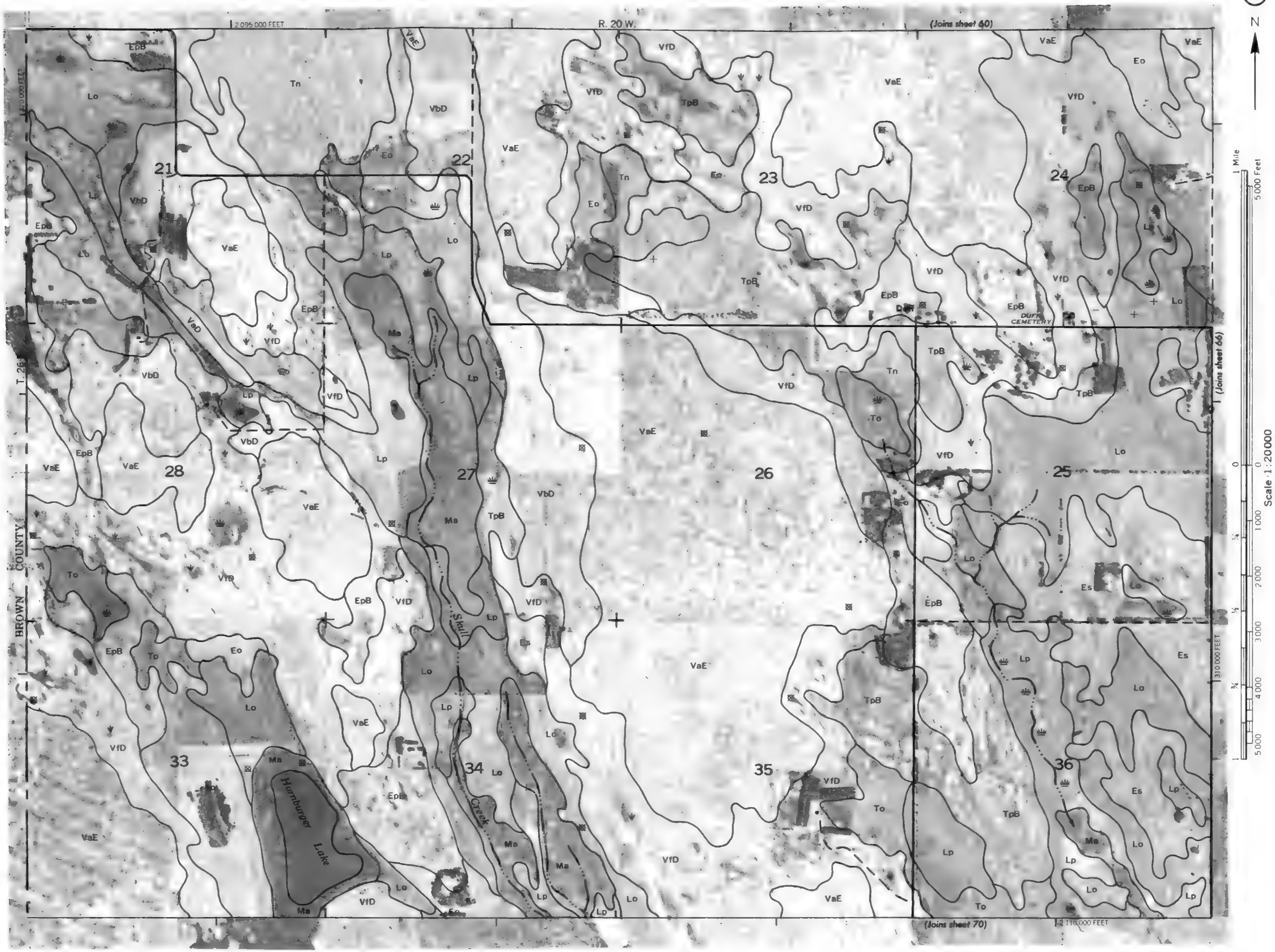
ROCK COUNTY, NEBRASKA NO. 63

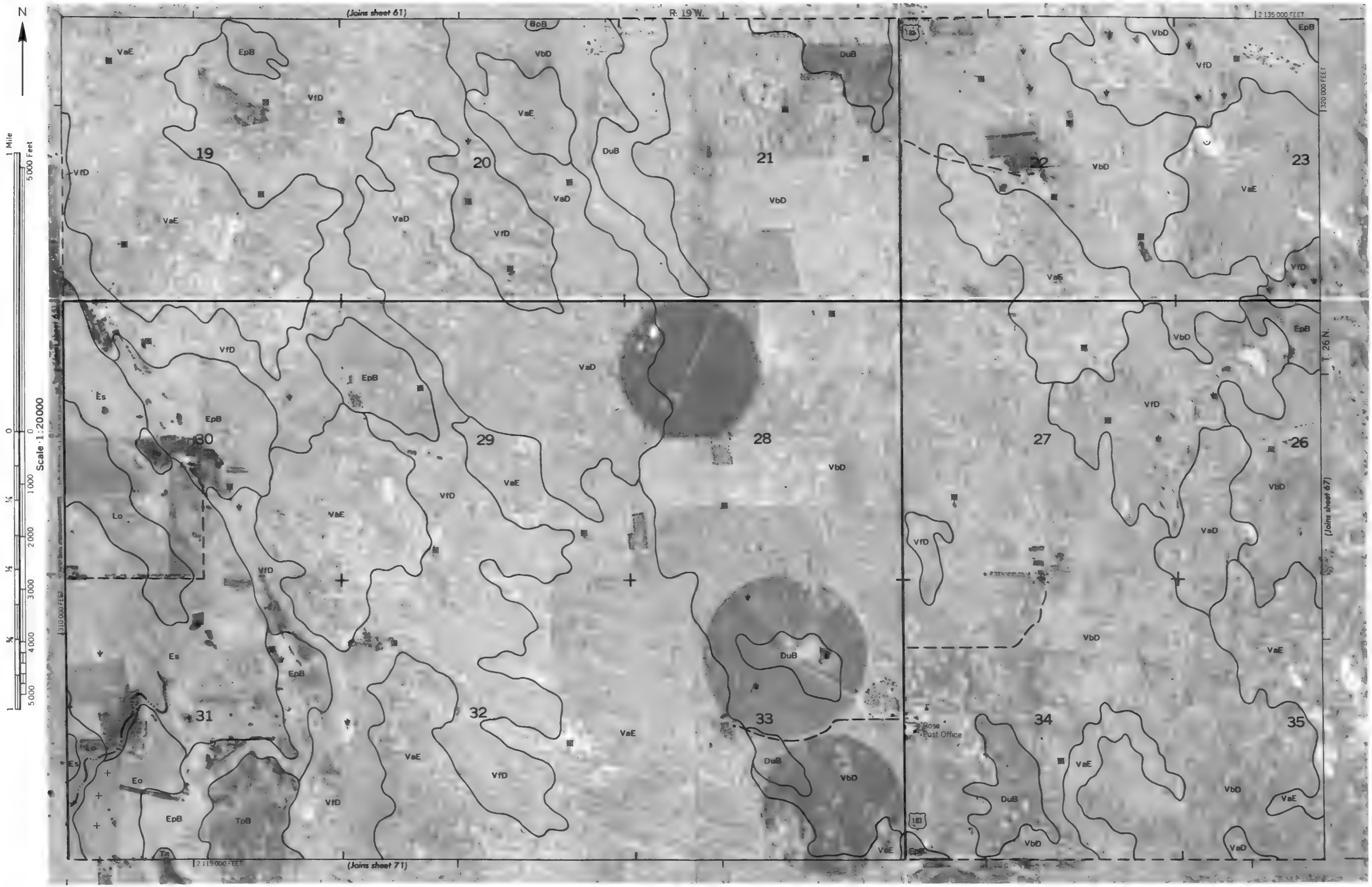




ROCK COUNTY, NEBRASKA NO. 64

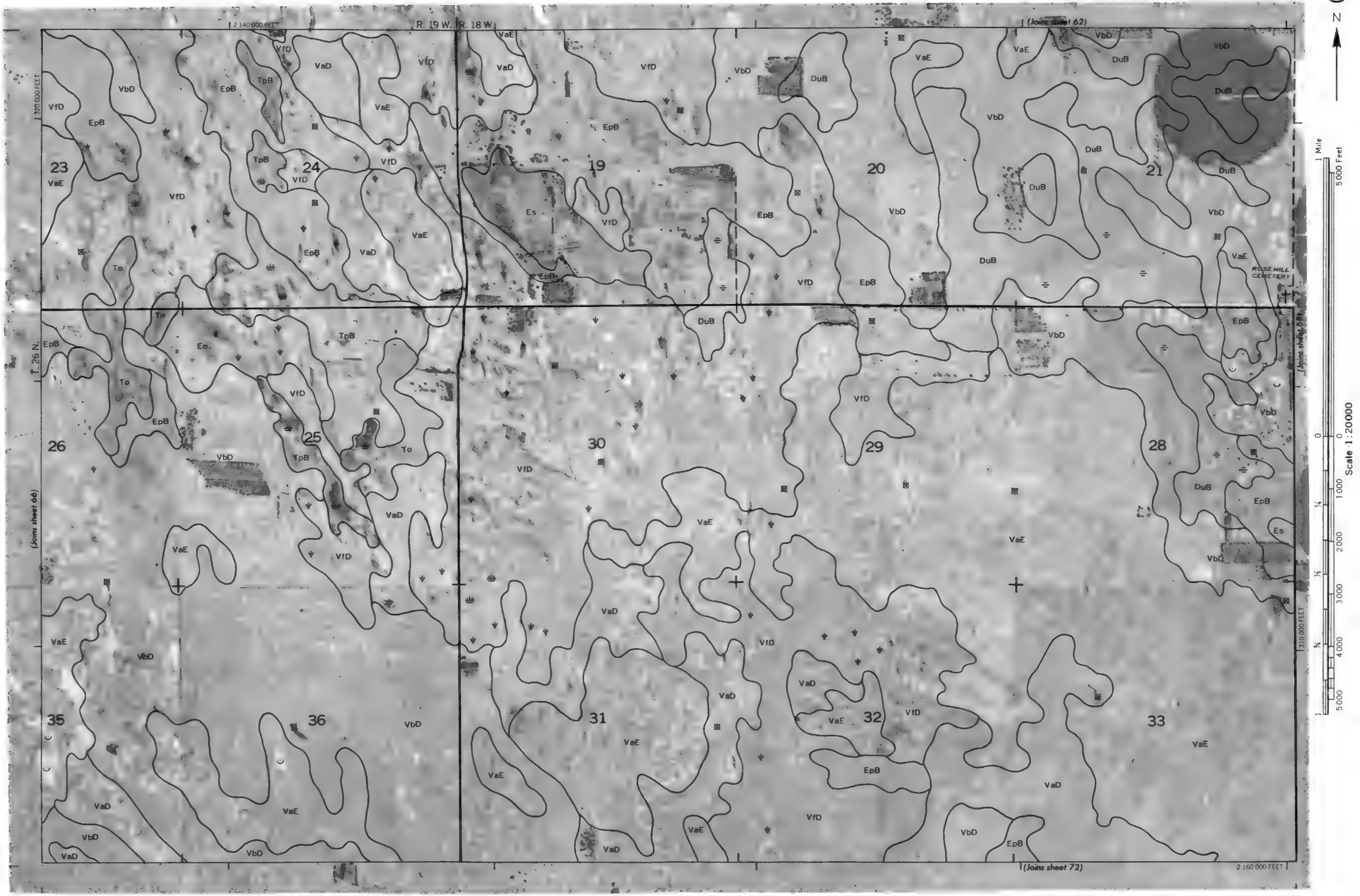
ROCK COUNTY, NEBRASKA NO. 65





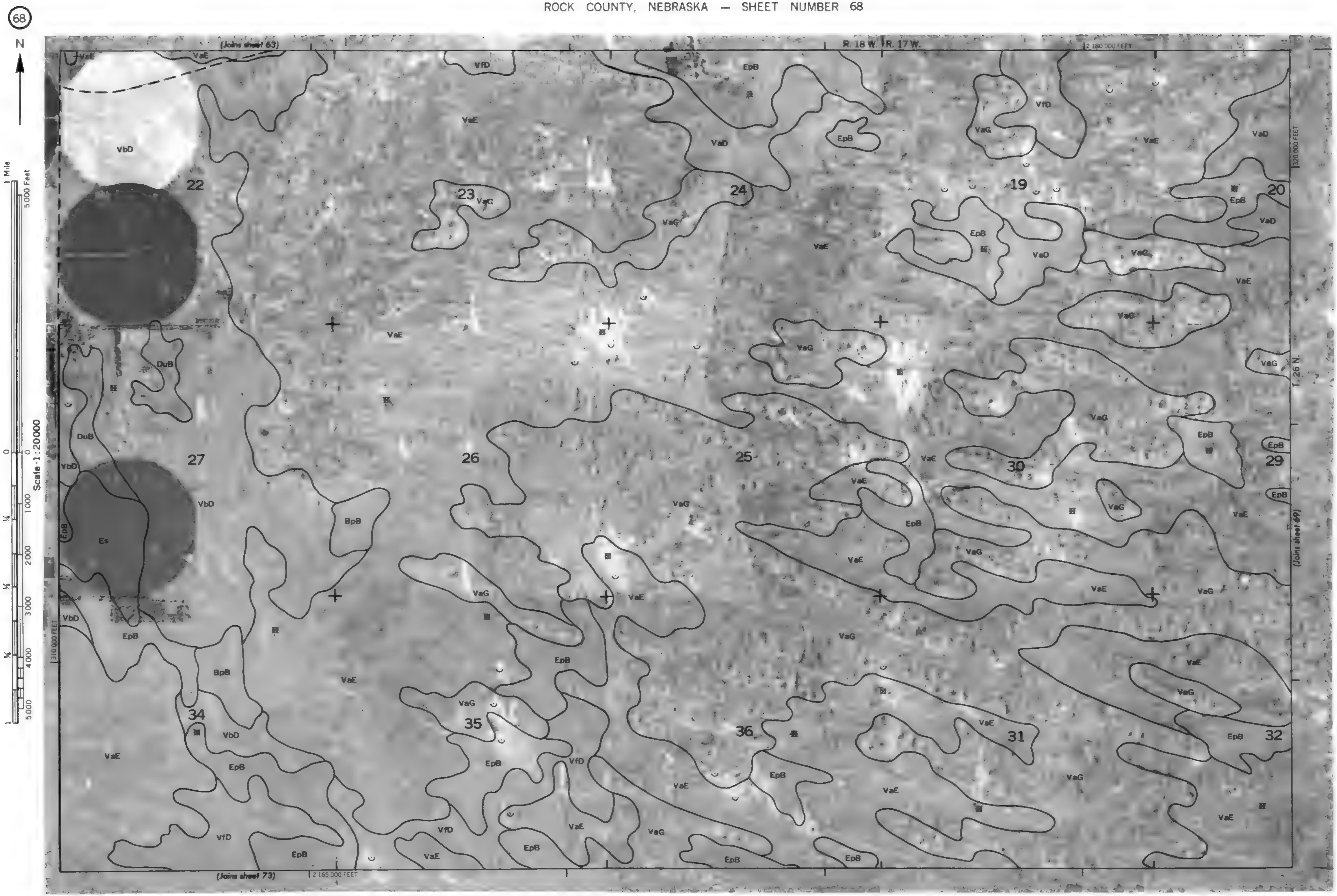
This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ROCK COUNTY, NEBRASKA NO. 66



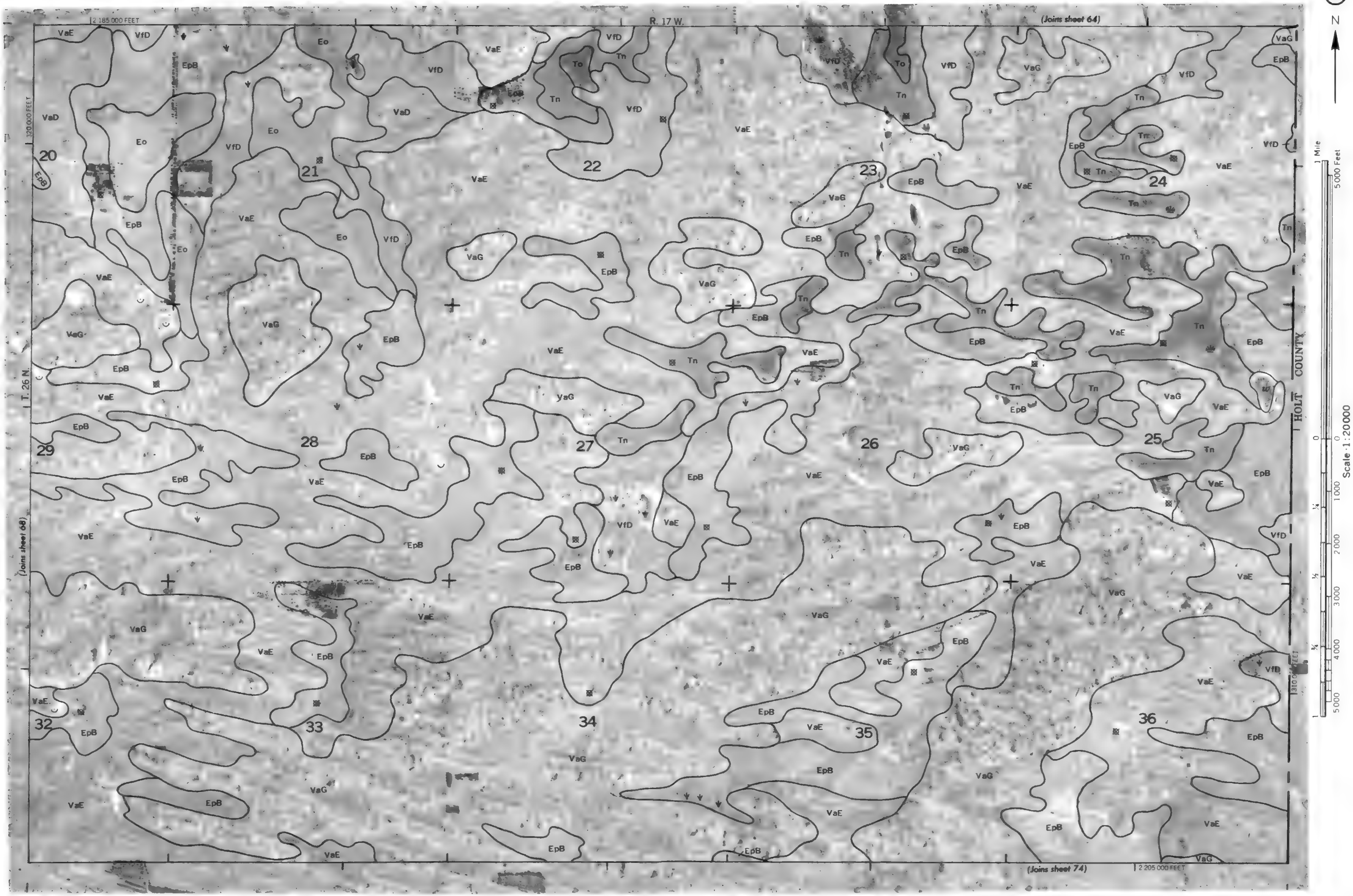
ROCK COUNTY, NEBRASKA NO. 67

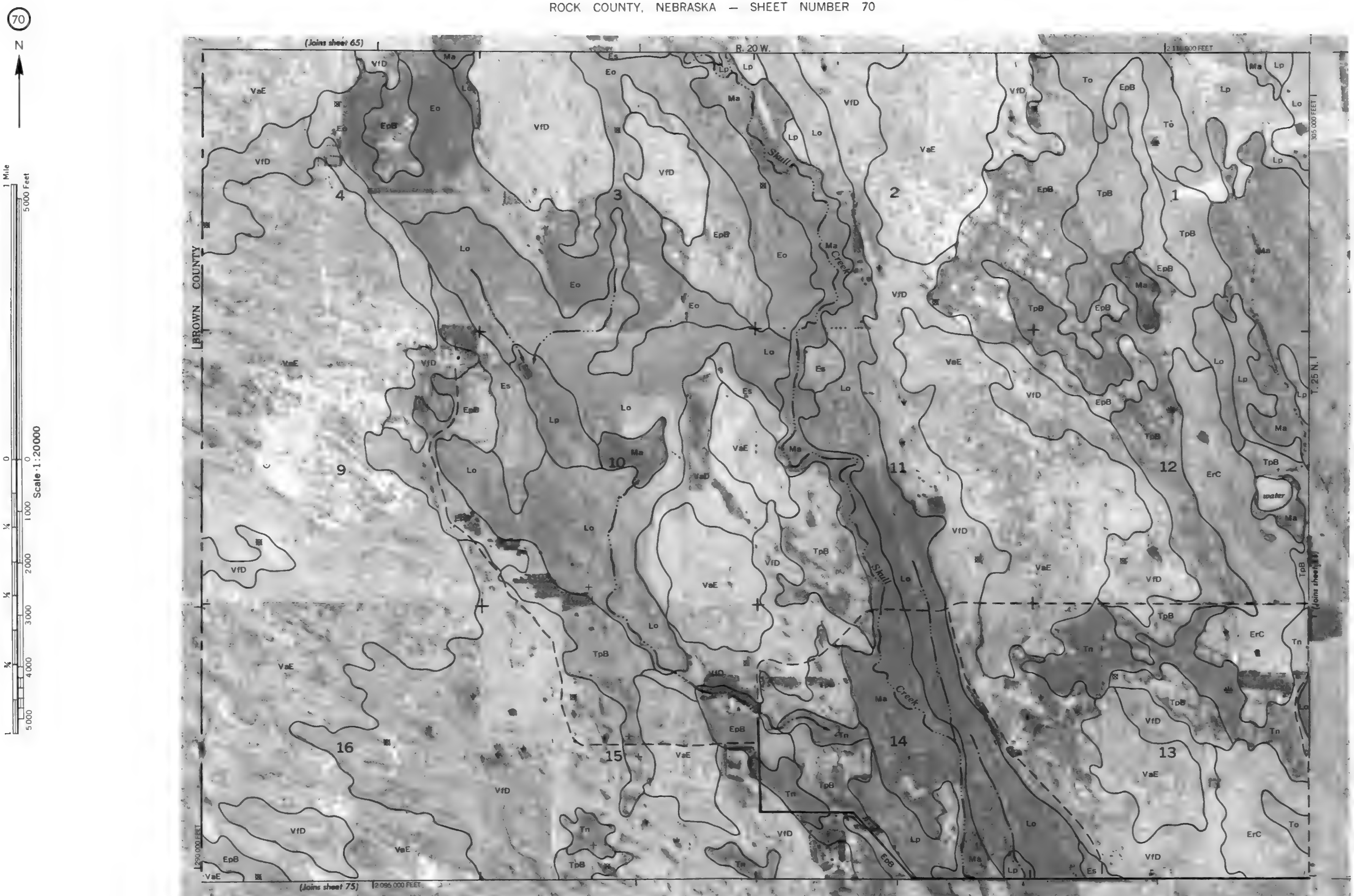
This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



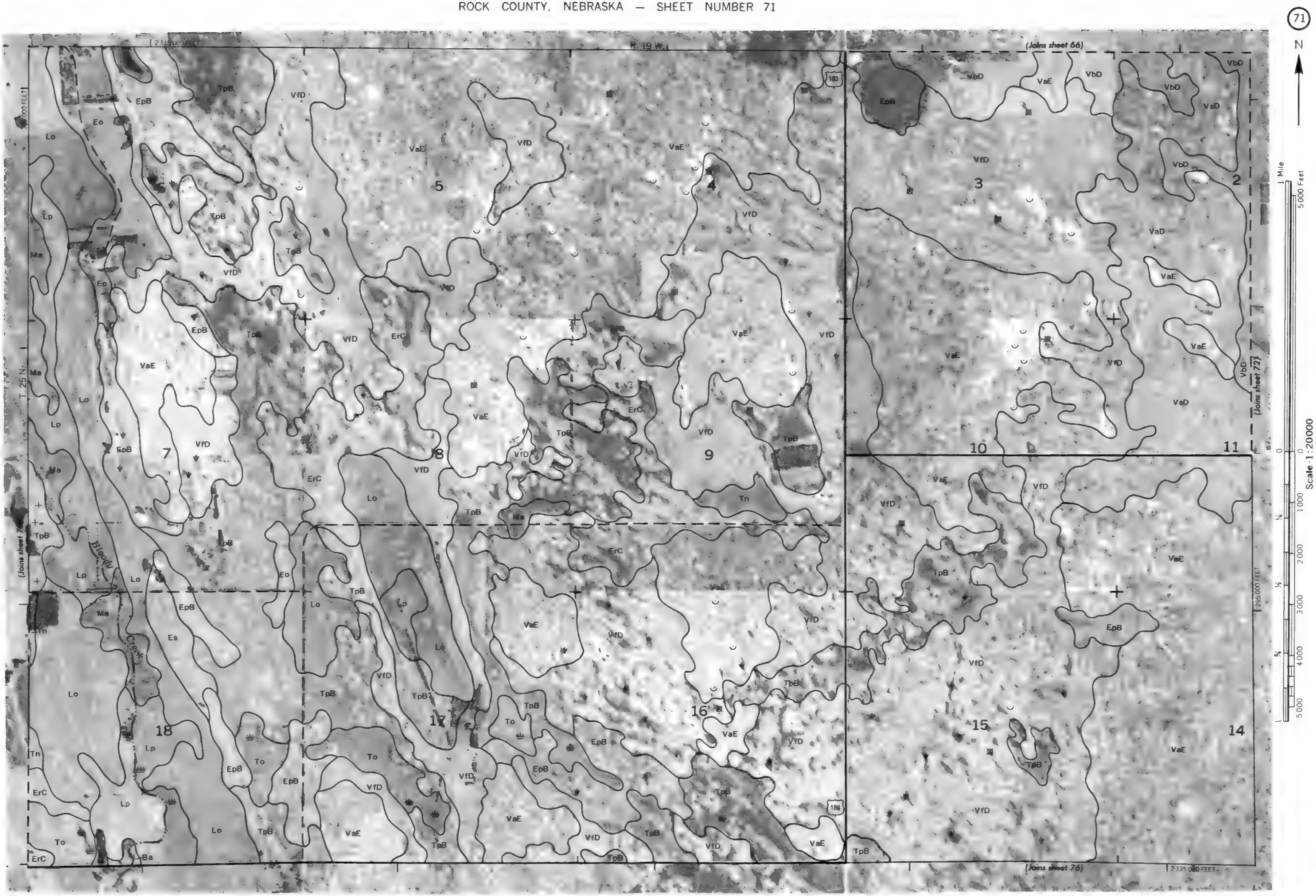
This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ROCK COUNTY, NEBRASKA NO. 69



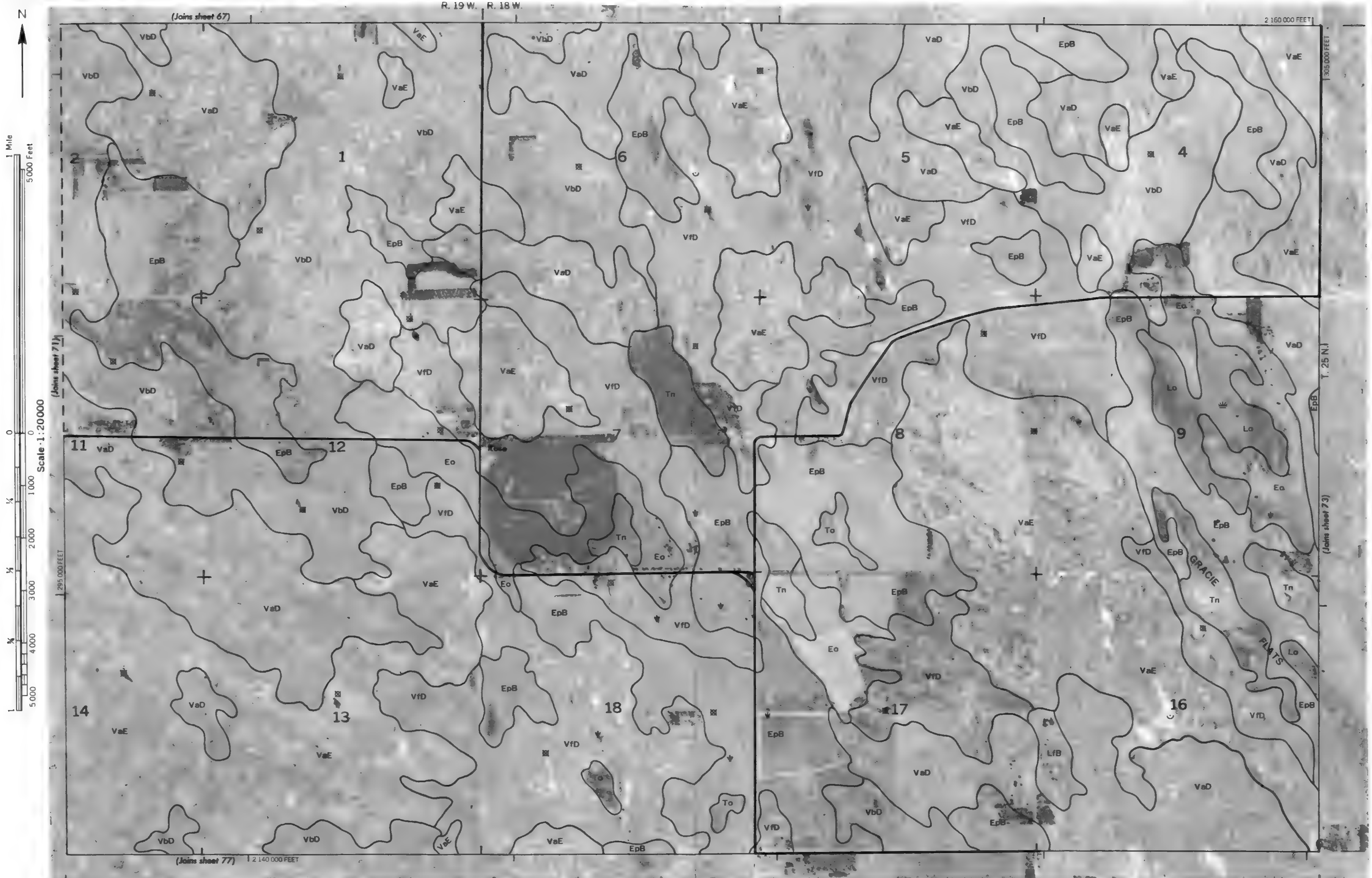


This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

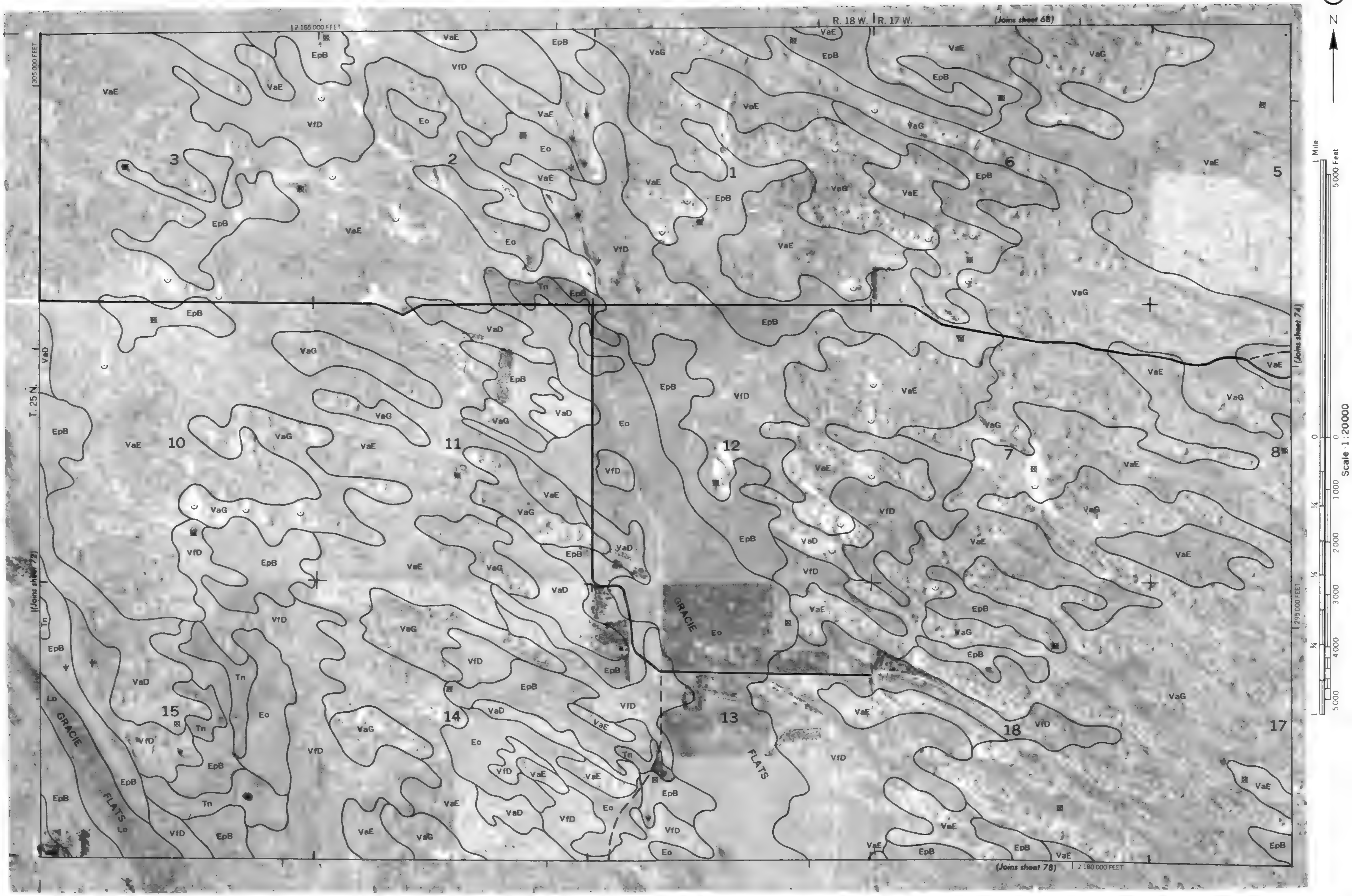


ROCK COUNTY, NEBRASKA NO. 71

This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

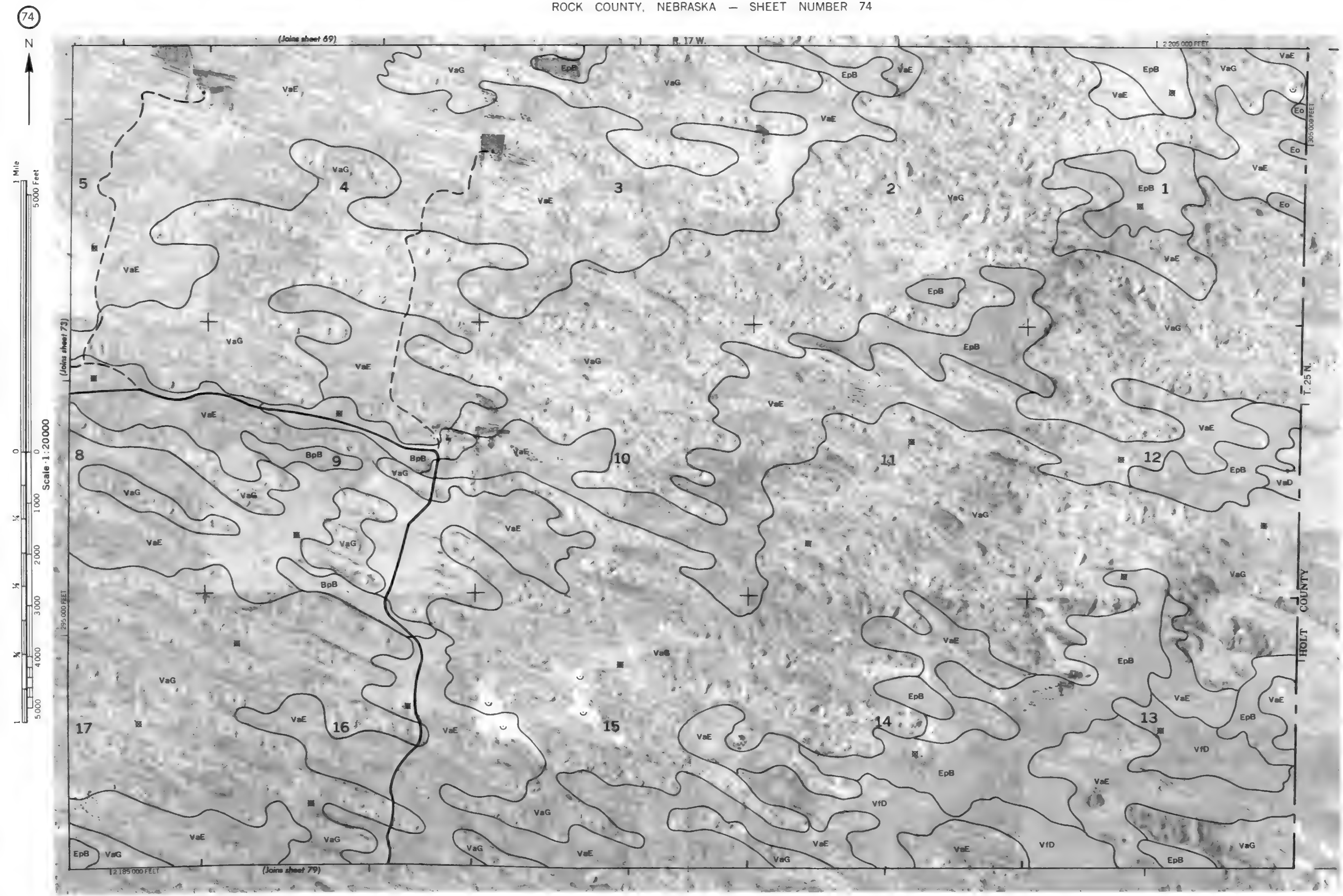


This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



ROCK COUNTY, NEBRASKA NO. 73

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

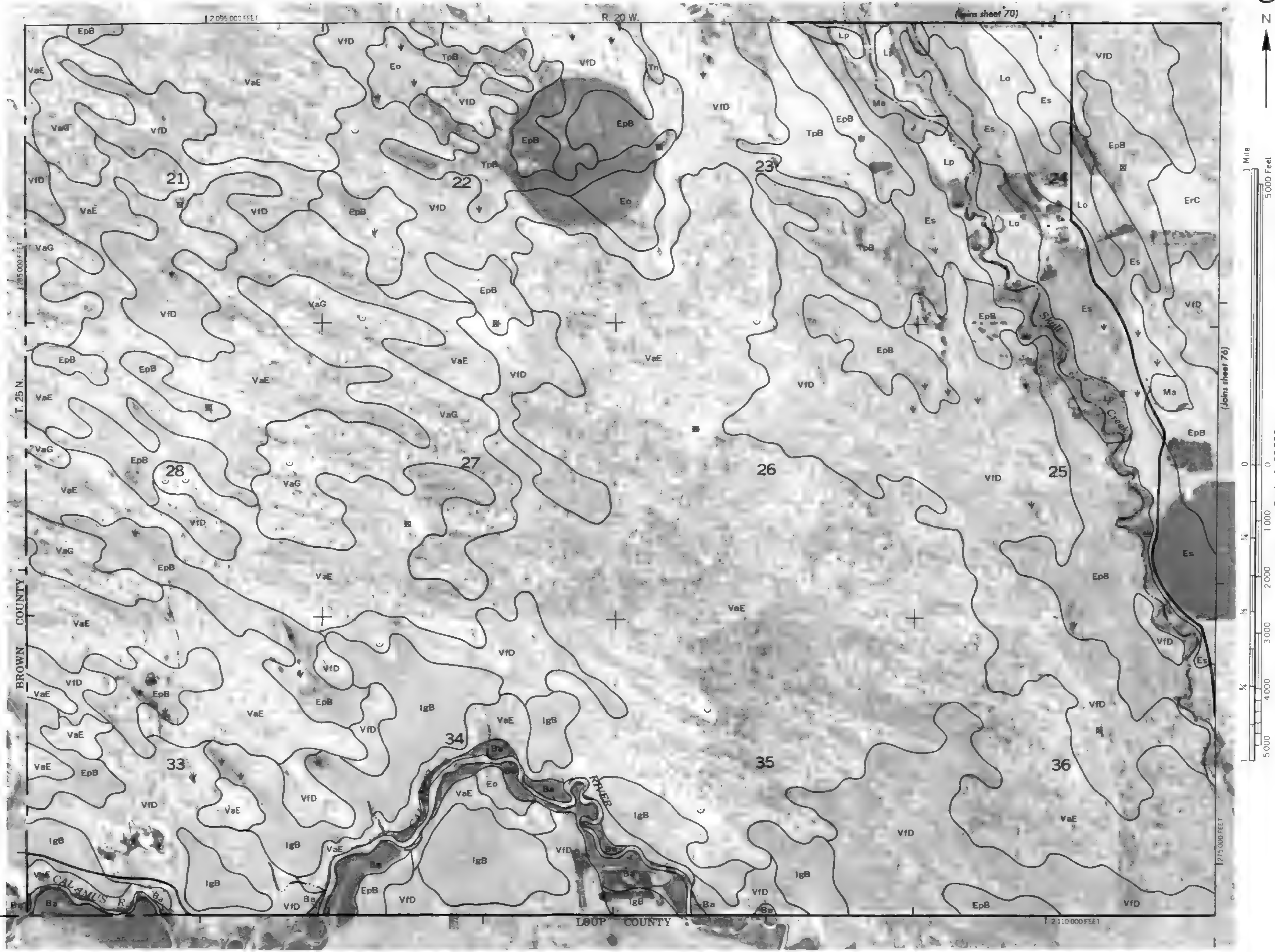


This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ROCK COUNTY, NEBRASKA NO. 74

75

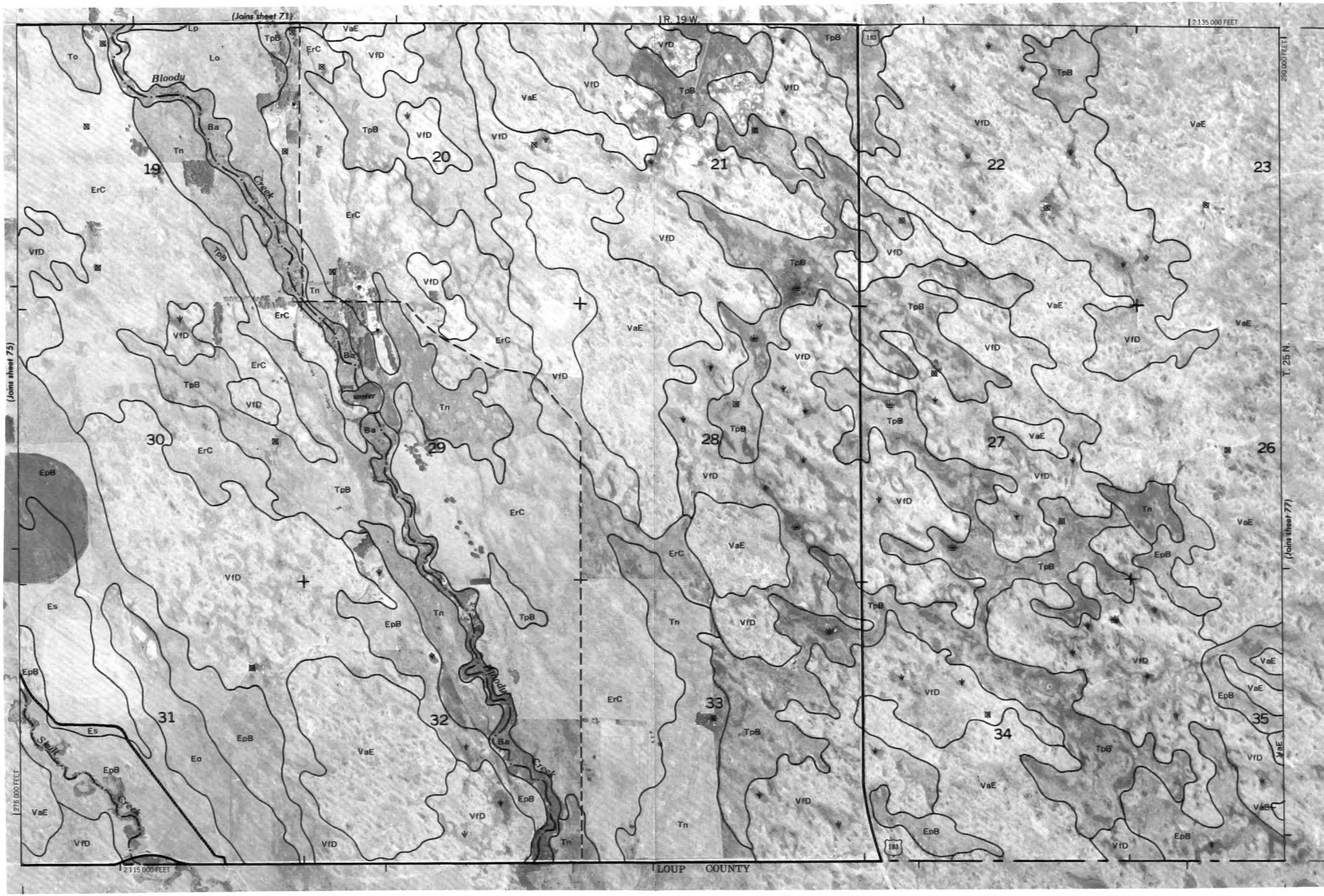
ROCK COUNTY, NEBRASKA NO. 75



76

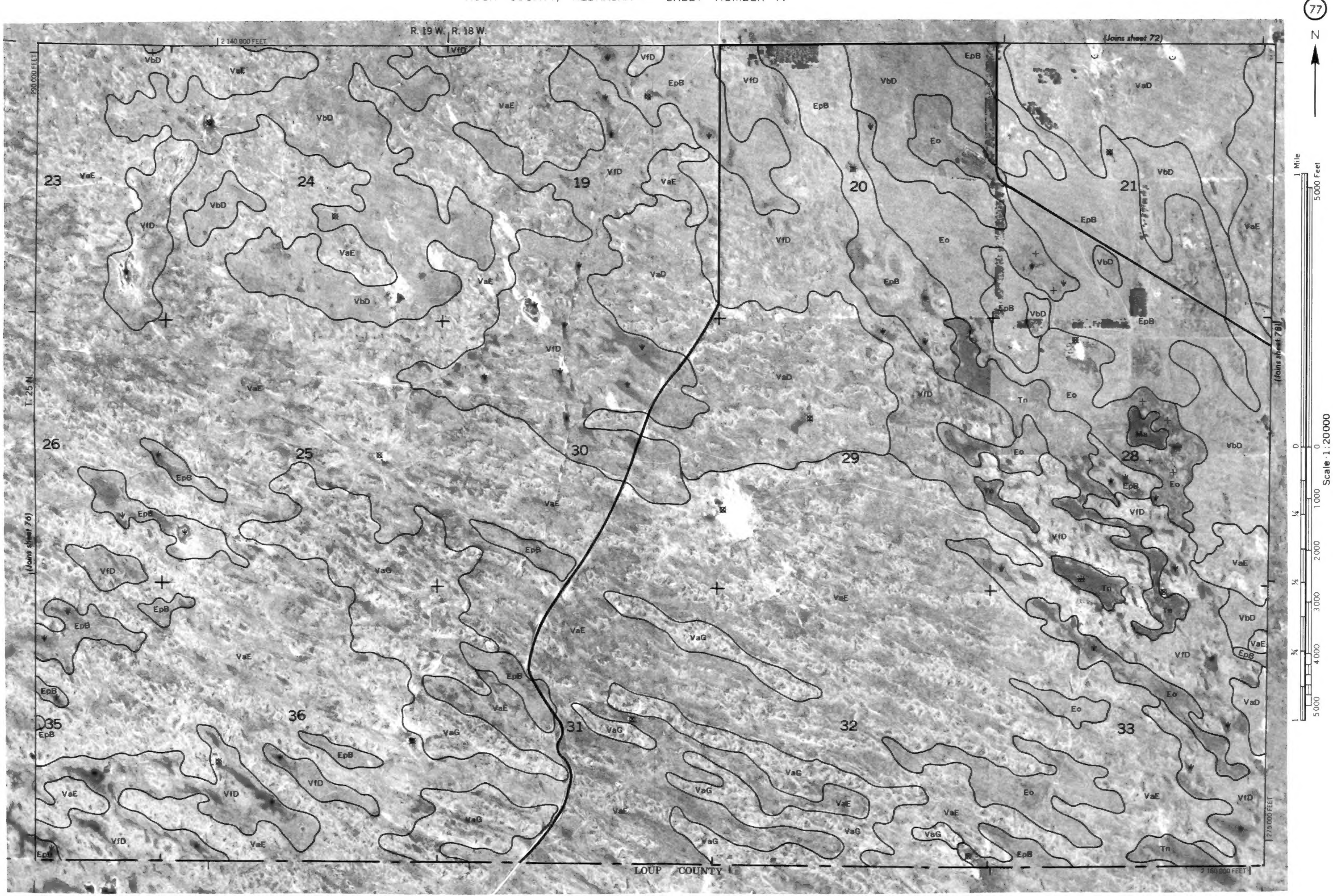
N

1 Mile
5000 Feet
0
1000
2000
3000
4000
5000
Scale 1:20000



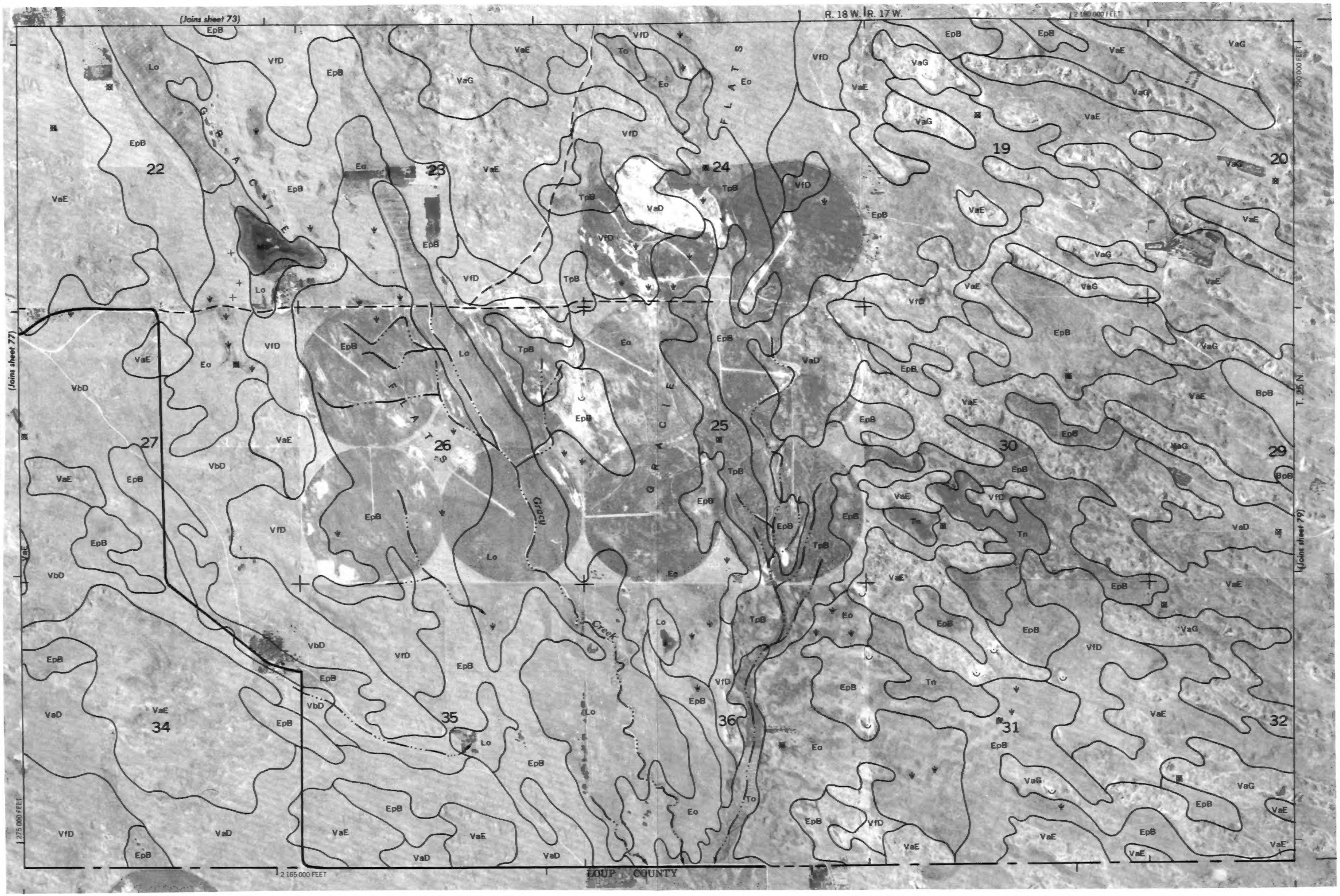
This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ROCK COUNTY, NEBRASKA NO. 76



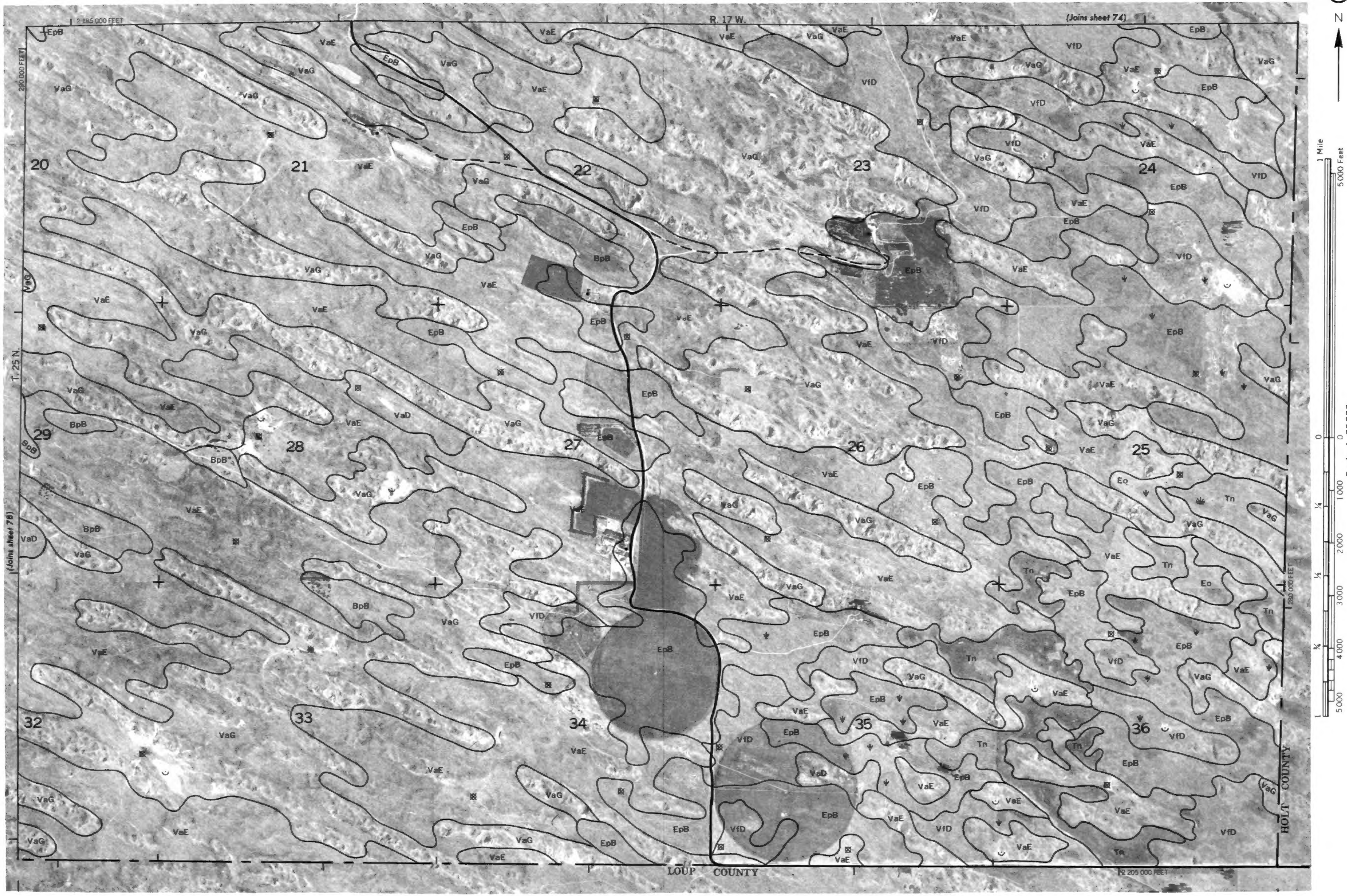
ROCK COUNTY, NEBRASKA NO. 77

This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners, if shown, are approximately positioned

ROCK COUNTY, NEBRASKA NO. 78



ROCK COUNTY, NEBRASKA NO. 79

This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.